DEPARTMENT OF HEALTH
FOR SCOTLAND

INFANT MORTALITY IN SCOTLAND

The Report of a Sub-Committee of the SCIENTIFIC ADVISORY COMMITTEE

EDINBURGH
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
120 George Street, Edinburgh 2; York House, Kingsway, London, W.C.2;
39–41 King Street, Manchester 2; 1 St. Andrew's Crescent, Cardiff
80 Chichester Street, Belfast;
or through any bookseller
1943
Price 1*s.* 3*d.* net

TERMS OF REFERENCE AND COMPOSITION OF THE COMMITTEE

1. At the request of the Secretary of State for Scotland, the Scientific Advisory Committee of the Department of Health for Scotland appointed a Sub-Committee with the following terms of reference:

> To consider the high infantile mortality experience in Scotland, with a view to estimating its principal causal factors and suggesting lines of action to ensure its reduction.

2. The Committee was constituted as follows:

Sir John Boyd Orr, D.S.O., M.C., M.D., D.Sc., LL.D., F.R.S., Director of the Rowett Research Institute, Bucksburn, Aberdeenshire (*Chairman*).

Dugald Baird, B.Sc., M.D., F.R.C.O.G., Regius Professor of Midwifery, University of Aberdeen.

Charlotte A. Douglas, M.D., F.R.C.O.G., D.P.H., Department of Health for Scotland, Edinburgh.

Jane P. Ferlie, M.B.E., Matron, Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh.

Stanley Graham, M.D., F.R.F.P.S., Visiting Physician, Royal Hospital for Sick Children, Glasgow.

James Hendry, M.B.E., M.A., B.Sc., M.B., Ch.B., F.R.C.O.G., Regius Professor of Obstetrics and Gynæcology, University of Glasgow.

Isabella Leitch, M.A., D.Sc., Deputy Director, Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeenshire.

Sir Alexander Macgregor, O.B.E., M.D., D.P.H., F.R.F.P.S., LL.D., Medical Officer of Health for Glasgow.

Jean M. Mackintosh, M.D., D.P.H., Regional Medical Officer for Maternity and Child Welfare, Aberdeen.

Peter L. McKinlay, M.D., D.P.H., F.R.S.(Ed.), Department of Health for Scotland, Edinburgh.

Charles McNeil, M.A., M.D., P.R.C.P.E., F.R.C.P.(London), Professor of Child Life and Health, University of Edinburgh.

Margaret Scott-Dickson, M.B., Ch.B., D.P.H., Maternity and Child Welfare Department, Dundee.

Elenora J. Simpson, M.B., Ch.B., The James MacKenzie Institute, St. Andrews.

Nora I. Wattie, M.B., Ch.B., D.P.H., Senior Child Welfare Medical Officer for Glasgow.

John B. Swan, Department of Health for Scotland, Edinburgh. } *Secretary to the Committee.*

3. The Committee met to consider evidence prepared and circulated by its members and appointed a Sub-Committee to prepare a full report.

4. The Drafting Sub-Committee was as follows:

Professor Baird (*Convener*), Dr. Graham, Dr. Mackintosh, Dr. Leitch,

with the assistance of:

Dr. Douglas,
Dr. McKinlay,
Mrs. F. L. Cutting, M.Sc.

INFANT MORTALITY IN SCOTLAND

FOREWORD

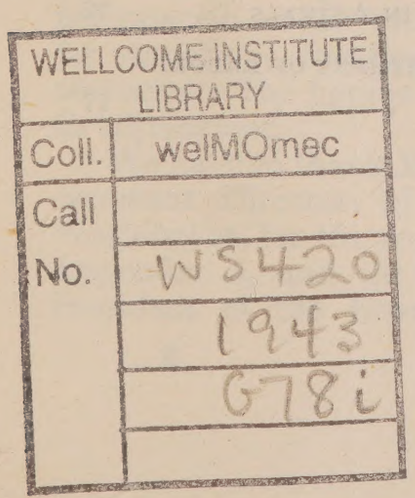
THE conclusions—perhaps still more, the implications—of this momentous Report, should be drawn to the attention of every Scotsman and Scotswoman.

Most of the facts and figures, and particularly the figures showing that our Infant Mortality rate is 40 per cent. worse than England's and is higher than the rate in any British Dominion or the U.S.A., higher than in Éire, higher than in any nation in Western Europe except Spain and Portugal—these figures have already been the subject of anxious comment.

But here for the first time all the known comparisons are carefully marshalled and a medical committee of great experience and authority, under the chairmanship of one of the leading nutritional scientists of our time, has diagnosed the cause or causes of the lamentable place Scotland takes among the great nations in the saving of infant life.

Our infant mortality compares badly with England's ; but it is not without significance that so, year after year, do our unemployed figures and our percentage of overcrowded houses. These have been the chief blots upon our social arrangements in the past and they have been productive of the most part of the poverty evils from which we have suffered. It is interesting to note that the industrial town of Falkirk, which has the smallest unemployment among the large burghs, has one of the smallest rates of infant mortality.

We are seeking through the Council of Industry and by other means to find employment for larger proportions of our fellow-citizens, and we are planning tremendous housing developments. But remedies and alleviations must be found for our infant mortality position in the immediate post-war years. They can be found and applied by Local Authorities, Medical Practitioners and Associations of men and women of goodwill, and to them all I commend an earnest study of this Report.



Thomas Johnston

SECRETARY OF STATE FOR SCOTLAND.

TABLE OF CONTENTS

INTRODUCTION

IN accordance with our instructions we have made an investigation into the causes of the high infant death rate in Scotland. For reasons which will become apparent in the course of this study we consider that, to get a true picture of the total loss of infant life, it is necessary to include stillbirths within the scope of our investigation.

The Committee has confined its attention to pre-war conditions, except in the discussion of stillbirths in Scotland, where it was necessary to take into account the statistics for the years 1939 to 1941. The reasons governing this decision were that there is little published information for the war years ; that the most important environmental conditions, diet, housing, employment and medical services, are highly abnormal in most areas ; and it is impossible to judge to what extent any of the changes which have occurred since the end of 1939 are likely to be permanent.

The **Infant Mortality Rate** is the number of registered deaths of infants under the age of twelve months during any year per 1,000 live births registered during the same year.

The **Neonatal Mortality Rate** is the number of registered deaths under one month of age per 1,000 live births registered during the same year.

The **Stillbirth Rate** is the number of stillbirths registered during the year per 1,000 live and stillbirths registered during the same year. The definition of a stillbirth is " any child which has issued forth from its mother after the twenty-eighth week of pregnancy and which did not at any time after being completely expelled from its mother breathe or show any other signs of life."

Prematurity : In 1938, a joint committee of the Royal College of Physicians of London and the British College of Obstetricians and Gynæcologists adopted the following standard of prematurity :

> " That in conformity with the standard in international use an infant whose birth-weight is 5½ lb. (approximately 2,500 grammes) or less shall be considered, for the purpose of comparison of records, as either immature or prematurely born, according as the estimated period of gestation is full time or less."

The task of preparing this Report has been made less easy because official statistics generally provide information only on the more obvious aspects of infant mortality and the statistics for Scotland provide even less information than is available for England and Wales and some other countries. Further, the customs governing registration of birth, and the definitions of stillbirth and modes of expressing mortality rates, differ in many countries from established practice here. The international comparisons made in the Report are therefore not, in all cases, strictly accurate but the errors involved are small in relation to the magnitude of the differences shown.

Our thanks are due to the Statistics Department of the Ministry of Labour and National Service for information on unemployment ; the Registrar-General for Scotland for permission to quote from the Annual Report for 1939 and for information on the Vital Statistics of the Netherlands ; the Ministry of Health for statistics ; the Registrar-General for England and Wales for unpublished statistics. The figures quoted for years since 1938 are provisional and subject to adjustment.

We have to thank Miss Katherine Lenroot, Director, and Miss Marian Crane, Assistant Director, of the Children's Bureau, U.S. Department of Labor, Washington, for the account of maternity and child welfare services, printed as Appendix 3, and for informative literature; Dr. Hermann N. Bundesen, President of the Board of Health, Chicago, for descriptive reports ; Dr.

Rowland Wilson, Department of Labour and National Service, Australia, and Dr. H. Watt, Director-General of Health, New Zealand, for specially prepared accounts of conditions in Australia and New Zealand which, we regret, were received when this report was already in the press and too late for inclusion.

We also wish to express our appreciation of the work of the Secretary, Mr. J. B. Swan, whose efficient help has contributed greatly to the success of the work of the Committee, and our thanks to other officials of the Department of Health for Scotland for their assistance.

SUMMARY OF EVIDENCE

THE evidence presented applies almost entirely, except for Part II, Stillbirths, to conditions up to 1939.

Part I.—The Mortality of Live-Born Infants

Scotland has the highest infant mortality rate of seventeen countries, including the Dominions, the United States of America and all the countries of Western Europe, except Spain and Portugal.

The problem of this high mortality has been analysed in two parts : deaths under one month of age (neonatal mortality) and deaths between one month and twelve months. To bear comparison with New Zealand or Holland, Scotland would have to reduce neonatal mortality by 30 per cent., and mortality between one and twelve months by 75 per cent. It is therefore obvious that success is more likely to follow quickly on efforts to improve the latter than the former. The saving of lives by these reductions would be 3,640 annually.

Comparison of the death rates in different areas shows that there is, in Scotland, a general heaping up of adverse conditions contributing to high infant mortality, affecting both rural and urban areas, greatest in the West Central (urban) and North East (rural)areas.

Study of the causes of death shows that prematurity and deaths ascribed to " congenital debility " are mainly responsible for the excess mortality in the first month. The causes are therefore mainly operative before birth, but some reduction could be effected by improving nurseries and nursery staffing in maternity hospitals so that premature and sick babies can be isolated, and neonatal infection brought under stricter control.

The excess between one and twelve months is due chiefly to infectious diseases. To understand this finding, it is necessary to appreciate the nature of the adverse environmental conditions contributing to the high incidence of, and mortality from, infections.

These are in the main poverty, faulty feeding and poor housing. In Scotland, as compared with England and Wales, the percentage of unemployment is higher, the proportion of people living in poverty twice as high and the percentage of overcrowding six times as great. In addition, especially in the industrial belt, severe winter conditions influence child life adversely and tend to increase the severity of the commoner infectious diseases of children.

The birth rate among the Scottish poor is at a high level such as is desired for the whole population. Families are therefore larger. This in itself increases poverty since wages are not adjusted to the size of the family. But the experience of New Zealand and Holland shows that a high birth rate need not be accompanied by a high infant death rate.

Part II.—Stillbirths

The excess of stillbirths in Scotland is as great as the excess of neonatal deaths.

Examination of the causes of stillbirth shows that about two-thirds are referable to antenatal conditions, i.e. to poor physique and poor health of the mothers, and only one-third to the hazards of birth.

A review of data suggests that improvement in obstetrical practice should reduce the stillbirth rate in Scotland from 42 (in 1939) to about 33, and that extended and improved antenatal medical supervision should reduce it still further and certainly to less than 30. But the basic rate attainable under the best conditions, where housing and diet, as well as obstetrics and antenatal care, are good, is of the order of 11 per 1,000 total births.

Reduction of stillbirths to the level in Holland would save 1,570 lives annually. This, taken with the possible saving of live-born infants, represents a total saving of 5,210 lives.

Part III.—The Feeding of Mothers and Infants

Working-class mothers are often underfed and their diets are of poor quality, deficient in materials for bone and blood formation and in vitamins needed for health. Such diets are important causes of poor physique and maternal ill health, premature birth, low vitality of the infant at birth and inability of the mother to suckle and care for her child.

It is considered of first importance that infants should be breast fed. To produce a sufficient quantity of milk of high quality, the mothers must be well fed. Evidence is presented which suggests that, on account of the high incidence of poverty and poor diets in Scotland, there may be a high proportion of unsatisfactory and short lactations.

Human milk is of special importance to the premature infant, but there is no organised breast milk service in Scotland.

The incidence of underfeeding and of malnutrition is high in bottle-fed babies. After weaning, underfeeding and poor diets, lacking sufficient milk and protective foods, are common in poor families. In both bottle-fed and weaned infants, the resulting malnutrition lowers resistance to disease and, taken with the excess exposure to infection due to bad housing and overcrowding, explains the high mortality from infections in Scottish infants.

Part IV.—The Medical Services

Scotland has lagged behind in the provision of maternity and child welfare services. Clinic premises are often poor, ill-equipped and overcrowded. Nutritional supervision is inadequate. Liaison between the hospitals, the family doctors and the child welfare service is poor.

Health visitors have usually much larger districts than they can efficiently manage.

Powers to supply extra food and domestic help are not sufficiently used by Local Authorities.

The maternity bed accommodation in Scotland is inadequate and voluntary hospitals in particular are overcrowded. There should be so many beds that all first births and all mothers with known disabilities and from poor houses could be admitted to hospital. Three times the number of beds available in 1937 are required, and this would represent only the minimum desirable.

The rules laid down by the General Medical Council and the Central Midwives Boards for the training of doctors, midwives and maternity nurses in obstetrics and the care of infants are satisfactory but they are not complied with, and the training is therefore inadequate. Insufficient attention is paid to the teaching of children's diseases and the principles of child health, and to the teaching of the principles of nutrition or their clinical application. Trained experts are required in all the maternity and child welfare services for supervision, consultation and advice in both of these subjects.

For such training there are not enough teachers and suitable teaching units do not exist.

RECOMMENDATIONS

THE Committee desires first to record its conviction that infant mortality in Scotland is high because a large part of the population, both in towns and rural areas, lives under poor housing conditions and in poverty. Unemployment has, in the past, seriously aggravated the problem, and recurrence of unemployment on any large scale would add greatly to the difficulty of its solution. There is little use of health education if the principles cannot be practised.

The Committee therefore makes the following recommendations :

1. Housing

No other measure taken to safeguard the health of infants is likely to have its full effect unless, at the same time, housing is improved. In Scotland the housing position is so bad that it cannot wait on formal town planning. There should be a temporary housing scheme to take the people out of the congested areas.

2. Food

The Committee notes with satisfaction that the Government has accepted the recommendations of the United Nations Conference on Food and Agriculture at Hot Springs, Virginia, 1943, and undertaken the task " of increasing the food resources and improving the diets of their people in accordance with the principles and objectives outlined in the findings of the Conference. . . ." The Committee recognises that it will not, at once, be possible to bring a diet, adequate for health, within the reach of every family. Much has already been done to improve the health of mothers and infants by the special measures taken by the Ministry of Food. Until the recommendations of the Hot Springs Conference have been implemented, these measures should be continued and extended as far as food resources permit.

3. Child Welfare Services

The child welfare services should be extended and improved. Education of mothers in infant feeding and domestic hygiene is of paramount importance and is the primary function of the service. The health visitor carries into the homes of the people the teaching of the medical staff at the welfare centre and her chief care is the health of the young child. Her training should be still further improved in the principles of mother and child care. The number of families for which a health visitor is responsible should be limited, and no health visitor wholly engaged in maternity and child welfare work should be responsible for the care of more than 500 children under five years of age. This is especially important as there is widespread ignorance of simple rules of hygiene and principles of dietetics amongst the masses in our large cities.

The medical staff should be more highly trained, especially in the principles of child health and nutrition. Their work should not be confined to child welfare clinics but they should be available for home visiting. They should be associated with hospitals caring for sick children and the work of the welfare centres and hospitals should be integrated.

Powers to provide home helps exist but are not sufficiently used. A greatly increased service of home helps should be organised by the Local Authority in all areas.

4. Antenatal Clinics

The antenatal clinic, where it exists, should be an essential part of the obstetric service and staffed by obstetricians. In these clinics more attention

should be paid to the diet of the expectant mother and instruction given in the principles of correct feeding. The services of dietitians and of doctors specially trained in nutrition work will be required.

5. Maternity Hospitals

More maternity hospitals, well planned and with full-time obstetricians in charge, are required. The aim in this expansion of the service should be to make possible the admission to hospital of all primigravidæ and all others with bad obstetrical histories or from unsuitable homes. Without extending the stay in hospital or making any allowance for the present increasing tendency to seek hospital confinement, at least 45 beds per 1,000 total births would be required, and this should be regarded as the first minimum to be attained.

The nurseries in maternity hospitals should have cubicles for premature infants and accommodation for the isolation of infections. They should be under the direct charge of adequate medical staffs specially trained in the care of infants. The problem of neonatal infection requires further investigation and the institution of stricter measures of control.

6. Training in Child Health and Nutrition

To provide the special training of the increased medical staffs required and to improve the services of the general practitioner, more attention should be given in the medical curriculum and in post-graduate courses to the teaching of child health and nutrition. The teaching should include instruction in the correct feeding of mothers and infants.

Education should be provided in schools in the general principles of health and preparation for parenthood.

7. Illegitimate and Boarded-out Infants

To avoid the difficulties and anomalies which arise from divided supervision, the Medical Officer of Health should be made Infant Life Protection Officer and the Health Visitor should be Infant Life Protection Visitor, responsible to the Medical Officer of Health. The administration of the Adoption Acts on behalf of the Local Authority should be solely in the hands of the Clerk to the Local Authority and the Medical Officer of Health.

(Signed)

John B. Orr (*Chairman*)

Dugald Baird
C. A. Douglas
Jean P. Ferlie
Stanley Graham
James Hendry
Isabella Leitch
A. S. M. Macgregor
Jean M. Mackintosh
P. L. McKinlay
Charles McNeil
Margaret Scott-Dickson
Elenora J. Simpson
Nora I. Wattie

J. B. Swan (*Secretary*)

20*th August* 1943.

PART ONE

THE MORTALITY OF LIVE-BORN INFANTS

CHAPTER 1—THE HIGH INFANT MORTALITY IN SCOTLAND

Total Mortality compared by Country : Table 1 shows the infant mortality rate in Scotland compared with other countries. The figures are for the pre-war quinquennium 1934–38.

Table 1.—Total Infant Mortality Compared by Country.
(Quinquennium 1934–38.)

New Zealand	32	Denmark	67
Holland	39	Éire	69
Australia	39	Canada	69
Norway	43	Finland	70
Sweden	45	**Scotland**	77
Switzerland	46	Spain	112
Iceland	48	Japan	115
U.S.A.	56	Poland	137
England and Wales	57	Hungary	141
S. Africa	58	Portugal	147
Germany	65	Egypt	163
France	67	British India	169
		Ceylon	184

From this it will be seen that the infant mortality rate in Scotland compared unfavourably with that in other parts of the English-speaking world and all other countries in the west of Europe except Spain and Portugal.

Total Mortality compared by Period : That this has not always been the case is shown in Table 2.

Table 2.—Total Infant Mortality Compared by Period.
(Quinquennia from 1871–1940.)

Quinquennium.	New [1] Zealand.	Holland.	Australia.	Norway.	Sweden.	U.S.A.	England & Wales.	Canada.	Scotland.
1871–75 .	102	—	—	—	—	—	153	—	127
1876–80 .		—	—	—	—	—	145	—	118
1881–85 .	91	181	125	99	116	—	139	—	118
1886–90 .	84	175	119	96	105	—	145	—	121
1891–95 .	88	165	109	98	103	—	151	—	126
1896–1900	80	151	112	96	101	—	156	—	130
1901–05 .	75	136	97	81	91	—	138	—	120
1906–10 .	70	114	78	—	—	—	117	—	112
1911–15 .	54	95	70	—	—	—	110	—	113
1916–20 .	49		65	—	—	93	90	—	99
1921–25 .	43	64	58	52	60	74	76	—	92
1926–30 .	37	56	52	49	58	66	68	93	85
1931–35 .	32	45	41	45	50	59	62	75	81
1936–40 .	32	37	39	39	42	51	55	64	76

[1] Excluding Maoris.

All countries show a decline over a period of years. Scotland, however, has shown only a slow rate of decline and from a relatively favourable position in

1871–75 has fallen behind in the race until, in the immediate pre-war period, it occupied the position shown in Table 1. The reversal in the relative positions of Holland, Scotland and England and Wales * is particularly noticeable (see Fig. 1). England and Wales and New Zealand have been able to reduce their

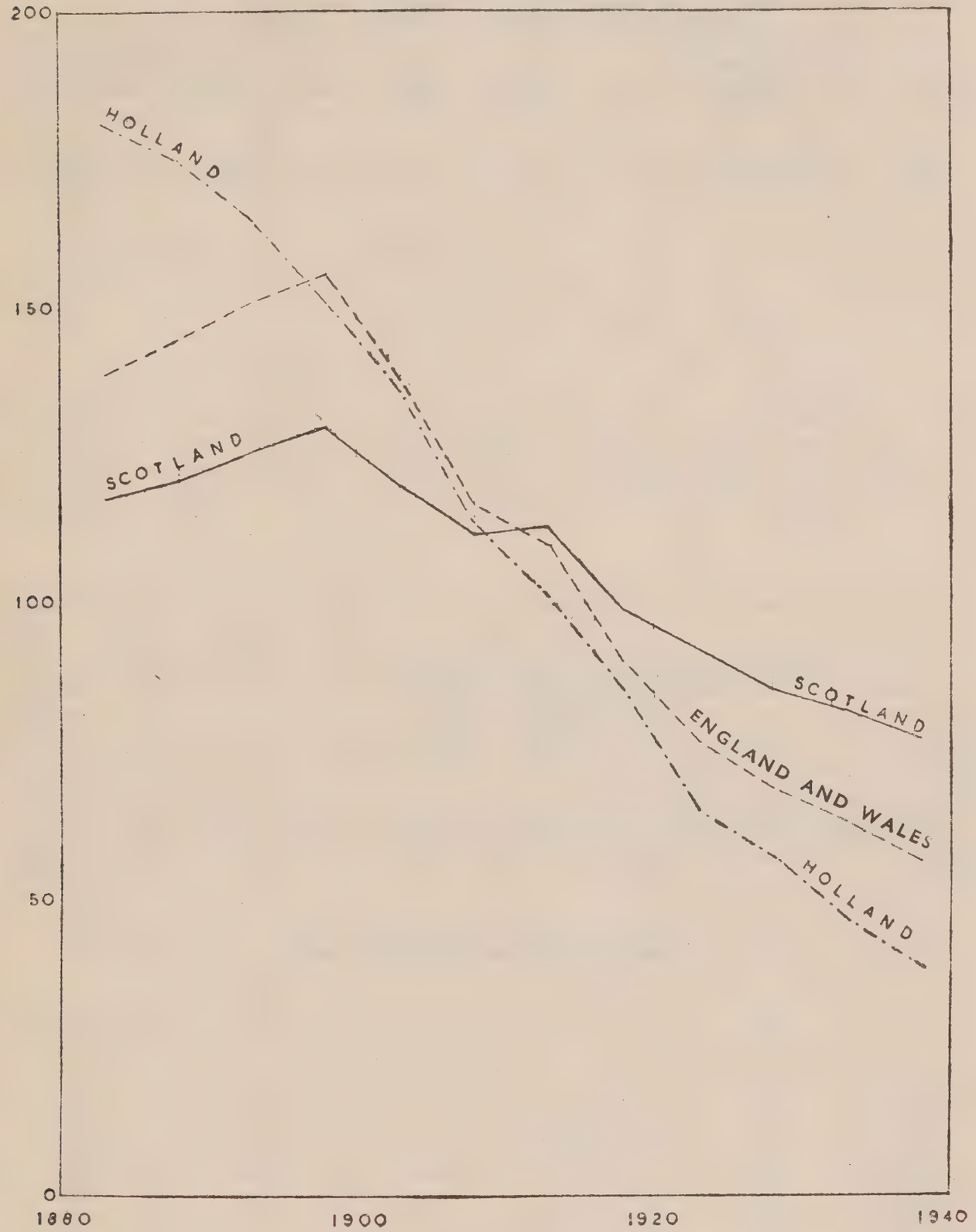


FIG. 1.
Infant Mortality Rates
Scotland, England and Wales, and Holland.
1880–1940

infant death rates by two-thirds of what they were sixty or seventy years ago, but Scotland has been able to reduce her infant death rate by only 40 per cent.

Neonatal Mortality and Mortality from 1 to 12 Months : A study of the incidence and causes of mortality during the first year has shown that the problem

* Wherever the phrase " England and Wales " occurs, it refers to the two together and does not imply that the statement is true of both England and Wales separately.

may most conveniently be analysed in two parts. Deaths between the end of the first month and twelve months of age may be largely attributed to environmental causes and those during the neonatal period in great part to causes relating to the health of the mother during pregnancy or the character of the labour. The evidence for this will be discussed below (p. 18).

In Table 3 the neonatal mortality and the mortality between one and twelve months in Scotland in the pre-war quinquennium are compared with those in seven other countries. Scotland has in each subdivision the same unfavourable place in relation to these countries as for total infant mortality.

Table 3.—Neonatal Mortality and Mortality between 1 and 12 Months. 1934–1938.

	Neonatal.	1–12 months.
New Zealand . . .	23	9
Holland . . .	22	17
Australia . . .	27	12
Norway . . .	23	20
U.S.A. . . .	32	24
England and Wales . .	30	27
Canada . . .	34	35
Scotland . . .	37	40

Scotland's neonatal mortality is 68 per cent. greater than that of the best countries and 23 per cent. greater than that of England and Wales. The mortality between one and twelve months is four times that of the best countries and one and a half times that of England and Wales. This suggests that the later mortality is more easily brought under control than the early. The historical comparison in the next section supports this suggestion. But, nevertheless, the neonatal mortality is very high and the mortality between one and twelve months excessively so.

Historical Comparison of Mortality under 1 Month and from 1 to 12 Months : The changes which have taken place in neonatal mortality and that during the rest of the first year in the same eight countries are shown in Tables 4 and 5.

Table 4.—Neonatal Mortality Rates

Period.	New Zealand.	Holland.	Australia.	Norway.	U.S.A.	England & Wales.	Canada.	Scotland.
1901–05 .	31	—	—	—	—	—	—	—
1906–10 .	30	—	—	—	—	40	—	—
1911–15 .	29	—	32	—	—	39	—	43
1916–20 .	28	—	—	—	43	37	—	41
1921–25 .	28	—	30	22	39	33	—	38
1926–30 .	25	24	29	25	37	32	45	37
1931–35 .	22	23	27	23	34	31	37	37
1936–40 .	23 [1]	21 [2]	27 [2]	—	30	29	32	37

[1] 1936–39. [2] 1936–38.

It will be seen that, in each country, the 1–12 months' component of infant mortality was originally higher than the neonatal, and has shown the greater decrease. In countries other than Scotland and Canada, it is now less than the neonatal mortality.

Scotland's improvement has been less in both components than that of any of the other countries shown. The neonatal rates of New Zealand, Australia, England and Wales, and Scotland have decreased by 21 per cent., 16 per cent., 26 per cent. and 14 per cent. respectively between 1911–15 and 1936–40. The

corresponding percentage decreases of mortality between one and twelve months are 60, 68, 63 and 44.

The data for New Zealand, Holland and Norway suggest that the neonatal rate has tended to stabilise at just over 20 ; mortality between one and twelve

Table 5.—Mortality between 1 and 12 Months

Period.	New Zealand.	Holland.	Australia.	Norway.	U.S.A.	England. & Wales.	Canada.	Scotland.
1901–05 .	44	—	—	—	—	—	—	—
1906–10 .	40	—	—	—	—	77	—	—
1911–15 .	25	—	38	—	—	71	—	70
1916–20 .	21	—	—	—	50	53	—	58
1921–25 .	15	—	28	30	35	43	—	54
1926–30 .	12	32	23	24	29	36	48	48
1931–35 .	10	22	14	22	25	31	38	44
1936–40 .	10 [1]	17 [2]	12 [2]	—	21	26	32	39

[1] 1936–39. [2] 1936–38.

months can be reduced to 10 or 12. Scotland would need to reduce her neonatal mortality by one-third and her mortality between one and twelve months by three-quarters to bear comparison with the best countries. This would save 3,640 infant lives annually, 1,080 in the first month and 2,560 between one and twelve months.

CHAPTER 2—DISTRIBUTION OF INFANT MORTALITY IN GREAT BRITAIN

Scotland compared with England and Wales : A comparison of the total infant mortality rates, the neonatal mortality rates, and the mortality rates between one and twelve months for Scotland and England and Wales, and various subdivisions thereof, is shown in Tables 6 (geographical areas) and 7 (urban and rural areas).

Table 6.—Infant Mortality Rates (I.M.R.), Neonatal Mortality Rates (N.M.R.) and Mortality between 1 and 12 Months (1–12) in Areas of Great Britain, 1934–38

	I.M.R.	N.M.R.	1–12		I.M.R.	N.M.R.	1–12
Scotland . .	77	37	40	England & Wales	57	30	27
North . .	63	34	29	South East excluding Gtr.			
South . .	65	37	28	London .	43	25	18
East Central .	67	37	31	South West .	47	28	19
West Central .	88	38	50	East . .	47	28	19
				Gtr. London .	54	24	30
				Midland .	57	31	26
				Wales . .	62	35	27
				North . .	66	34	32

From this it will be seen that West Central Scotland shows the highest infant mortality of any region in Great Britain. The remainder of Scotland, Wales and the North of England are all alike fairly bad. Greater London and the Midlands are fairly good and the predominantly rural areas of the South and East of England are best. The distribution of neonatal mortality is similar, although there is no such violent contrast between West Central Scotland and the other bad areas as there is in mortality between one and twelve months. Greater

London and the rest of the South East have neonatal rates almost as good as the best countries in the world, Holland, New Zealand and Norway.

The high rates in West Central Scotland are also shown in Figs. 2 and 3, which give the infant and neonatal mortality rates in the administrative

FIG. 2.
Infant Mortality Rates
1934–1938

counties (excluding the twenty-four largest burghs in Scotland and the eighty-four county boroughs of England and Wales) of Great Britain for the quin-

quennium 1934–38. Lanark, Ayr, Wigtown, Clackmannan and Durham have the worst infant mortality, and the N.E. of Scotland, the Lowlands, Wales and the North of England, are all high. The distribution of neonatal mortality is similar. It is interesting to note that the predominantly rural areas of S.W.

FIG. 3.
Neonatal Mortality Rates
1934–1938

and N.E. Scotland are as bad as, or worse than, the mining villages and small industrial towns of the Lowlands of Scotland and the N.E. of England.

The mortality over parts of the Highlands and Islands is low and bears comparison with the S.E. of England.

Urban and Rural Areas : When urban and rural areas in the two countries are compared (Table 7), the same difference in favour of England and Wales is

Table 7.—Infant Mortality Rates (I.M.R.), Neonatal Mortality Rates (N.M.R.) and Mortality between 1 and 12 Months (1–12) in Rural and Urban Areas of Great Britain, 1934–38

	I.M.R.	N.M.R.	1–12		I.M.R.	N.M.R.	1–12
Scotland				England & Wales			
Large Burghs .	86	38	48	Gtr. London .	54	24	30
Small Burghs .	65	} 36	29	Other County Boroughs .	65	33	32
Landward Areas [1] .	65			Other Urban Districts .	54	31	23
				Rural Districts	50	30	20

[1] In England, Rural Districts.

found in both types of area. Both in Scotland and in England and Wales, the infant mortality is lower in rural areas than in urban areas.

The excess mortality in urban areas in general suggests that certain town influences adversely affect infant mortality, but recent experience in the U.S.A. shows that such influences can be overcome. From 1915 to 1928 urban mortality was higher than rural, but since then the reverse has been the case. In the U.S.A., births and deaths are not allocated to the place of residence of the mother as in Great Britain, but to the place of occurrence of the birth or death. A special investigation in 1939 (Sommers, 1942) of infant mortality in the white population by place of residence showed that the mortality in cities (over 10,000) had been reduced to 41, and was below that in rural areas, 46 ; but that mortality in small towns (2,500–10,000) was still 50 and above both the city and rural death rates. "Towns provided the least favourable opportunity for infant survival, having apparently sacrificed the healthful environment of the rural area without having attained the superior facilities of the city." The experience of Holland, where the infant mortality rate (1930–32) in towns with a population over 100,000 was 37, and in rural areas 54, has been similar (Titmuss, 1943). The general surplus of adverse conditions in Scotland, affecting both rural and urban areas, places the special hospital and medical services at a disadvantage and prevents their full influence from being manifested.

Cities of Great Britain : The four Scottish cities are compared with cities or aggregates of cities of comparable size in England and Wales in Table 8 (p. 15).

From this it will be seen that the infant mortality rate in Glasgow in 1934–38 was 99, the highest of any city or large burgh in Great Britain. Its rate is 27 per cent. higher than that of Liverpool and 57 per cent. higher than that of Birmingham, cities of comparable size. It is 60 per cent. higher than that of the county of London and 83 per cent. higher than that of Greater London. The cities of Aberdeen and Dundee show rates of 76 and 77 ; Coventry, Southampton, Bolton and Swansea are all 20 to 25 per cent. lower ; only Sunderland is as high. Edinburgh is the only Scottish city which compares at all favourably with cities of similar size in England and Wales, but, even so, Bristol and Sheffield, with rates of 46 and 54, are lower.

Similarly the neonatal rates of the four Scottish cities, particularly Glasgow, are among the highest in the list.

Yet from the preceding discussion of urban and rural rates in U.S.A. and Holland, it is evident that the conditions of life in large cities need not be associated with a high infant mortality rate.

Table 8.—Infant Mortality Rates in Cities with Population over 160,000, arranged by Size, 1934–38

City.	Population in Thousands.	Birth Rate.	Infant Mortality Rate.	Neonatal Mortality Rate.	Mortality Rate 1–12 mths.
London, Administrative County	4,143	13·4	62	24	38
Glasgow	**1,119**	**19·7**	**99**	**40**	**59**
Liverpool, Bootle and Birkenhead	1,067	19·8	78	31	47
Birmingham	1,023	16·1	63	31	32
Manchester & Salford	949	15·1	75	35	40
Sheffield	519	15·1	54	31	23
Leeds	490	15·0	66	33	33
Edinburgh	**464**	**15·8**	**66**	**35**	**31**
Bristol	414	14·2	46	27	19
Newcastle & Gateshead	410	16·6	83	41	42
Hull	320	18·3	70	29	41
Bradford	291	13·6	67	36	31
Nottingham	280	15·6	78	34	44
Stoke-on-Trent	273	16·6	75	37	38
West Ham	265	15·8	60	24	36
Leicester	257	14·4	56	30	26
Portsmouth	253	15·2	49	25	24
Croydon	242	13·5	46	22	24
Cardiff	221	15·5	61	35	26
Plymouth	207	15·2	54	27	27
Coventry	197	15·3	52	31	21
Sunderland	184	19·7	80	36	44
Southampton	178	15·9	50	27	23
Dundee	**178**	**17·9**	**77**	**36**	**41**
Aberdeen	**176**	**17·4**	**76**	**35**	**41**
Bolton	173	12·9	56	32	24
Swansea	163	15·6	57	33	24

Foreign Cities : In Table 9 figures for foreign cities are compared with those of Scotland and Greater London. The cities chosen are the five largest in the U.S.A., the largest in the Dominions, and the capitals of Holland, Denmark, Norway and Sweden. The remarkable drop experienced by American cities between 1932 and 1940 is also shown.

Table 9.—Infant Mortality Rates, Selected Cities, 1938

	Population in millions.	Infant mortality rate.
Glasgow	1·1	87
Edinburgh	0·5	61
Dundee	0·2	77
Aberdeen	0·2	71
Greater London	8·7	50
New York	7·5	38
Chicago	3·4	34
Philadelphia	1·9	40
Detroit	1·6	41
Los Angeles	1·5	43
Montreal	1·1	73
Toronto	0·7	48

Table 9.—*continued.*

	Population in millions.	Infant mortality rate.
Sydney	1·3	39
Melbourne	1·1	37
Auckland	0·2	35
Wellington	0·1	38
Amsterdam	0·8	31
Copenhagen	0·8	38
Oslo	0·3	35
Stockholm	0·6	35

	1932	1934	1936	1938	1940
New York	51	52	45	38	35
Chicago	49	48	39	34	29
Philadelphia	52	54	48	40	[1]
Detroit	52	50	53	41	[1]
Los Angeles	56	53	56	43	[1]

[1] Rate not available.

These figures are further illustrated in Fig. 4 (opposite).

Occupational or Social Class Mortality in England and Wales : Table 10 shows the mortality of legitimate infants, according to the social class of the Registrar-General's classification by father's occupation.* In social class I are included those with the highest incomes ; in class V are those with the lowest incomes. No data for occupational or social class mortality are available in Scotland.

There is a steady rise in mortality from class I to class V at all ages under one year, which becomes more marked as the baby gets older. The neonatal

Table 10.—Mortality of Legitimate Infants according to Social Class of Father, England and Wales, 1930–32

Age.	Rate per 1,000 legitimate live births.						Mortality of Children of specified class per cent. of that of all legitimate children.				
	All Classes.	I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
Under 4 weeks	30·2	21·7	27·2	29·4	31·9	32·5	72	90	97	106	108
1–3 months	10·0	4·3	6·5	9·3	10·8	13·1	43	65	93	108	131
3–6 ,,	8·4	3·1	4·7	7·5	9·4	12·0	37	56	89	112	143
6–9 ,,	6·9	1·9	3·6	6·0	7·8	10·2	28	52	87	113	148
9–12 ,,	6·1	1·7	3·0	5·3	6·9	9·2	28	49	87	113	151
Under 1 year	61·6	32·7	45·0	57·6	66·8	77·1	53	73	94	108	125

* The five classes distinguished by the Registrar-General include : class I, higher ranks of business and professional life ; class II, retail trades, clerks, teachers, etc., farmers ; class III, skilled labour ; class IV, neither artisan nor wholly unskilled, farm labourers ; class V, unskilled labour. They are not co-extensive with income groupings, but an analysis of 5,000 families by Crawford and Broadley (1938) indicates, along with the fact that children tend to be concentrated in low-income families, that so far as families with children are concerned the association between class and income is very high.

mortality in class V is 50 per cent. greater than that in class I. Between one and three months, mortality is three times as great, between three and six months four times as great, and between six and twelve months five times as great.

From Tables 1 and 3, it will be seen that New Zealand's infant mortality rate (32) is comparable with that of social class I and Scotland's (77) with that of social class V. Similarly with neonatal rates; New Zealand's (23) is com-

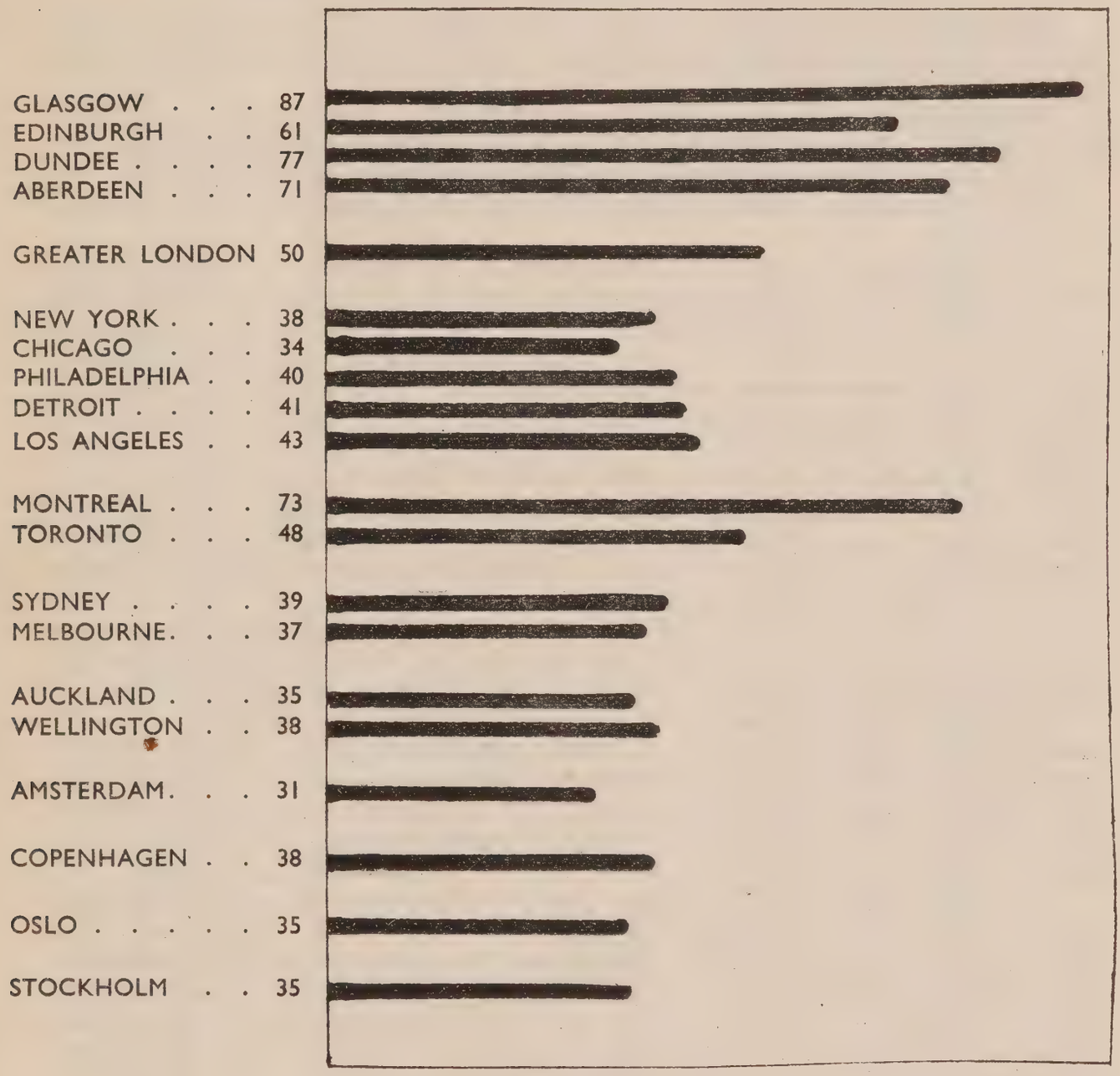


FIG. 4.

Infant Mortality Rates, 1938. Selected Cities

parable with that of class I, but Scotland's (37) is greater than that of class V.

It appears therefore that only the " upper ranks of business and professional life " in England and Wales had, ten years ago, attained the low standard of infant mortality established in New Zealand as a whole and that infant mortality in Scotland lagged behind at the level held by the poorer working classes in England and Wales.

In any big city in Britain a very wide range exists in the mortality in different wards. The poorest and most overcrowded districts have the highest

rates and the middle-class residential districts are much lower. In 1938, the wards with the lowest and highest infant mortality in Glasgow had rates of 47 and 131 ; in Edinburgh, 34 and 99 ; in Aberdeen, 19 and 94 ; and in Dundee, 47 and 127.

CHAPTER 3—THE CAUSES OF INFANT DEATH

Comparison by Country : The causes of infant death in different countries during the first month, during the period 1–12 months and for the whole year are shown in Table 11 (p. 19).

Neonatal deaths are recorded, in all countries, as due mainly to (*a*) prematurity and congenital debility, and (*b*) malformations and birth injuries. All other causes together account for only about one-fourth of the total.

In the succeeding eleven months, half or more than half the deaths are due to infections.

These facts make clear the reason, referred to in Chapter 1, p. 10, above, for differentiating between the two periods. Prematurity and congenital debility are, without doubt, largely referable to the condition of the mother during pregnancy. The ætiology of congenital malformations is not understood. Some may be examples of arrested or disturbed development, and, as such, related to antenatal conditions. Birth injuries may be due to poor maternal physique, as in rachitic pelvis ; to such physiological disturbances as uterine inertia ; or to faulty obstetrics. But the most frequent form of birth injury, cerebral birth trauma, at times associated with cyanosis, occurs in many cases where there is no obvious physical disability or obstetrical fault. This is especially true of premature infants. The great majority of neonatal deaths are therefore referable to antenatal causes.

On the other hand, it is mainly because of poor hygiene that infants contract acute infections, although their chances of survival may be seriously reduced by lack of reserves at birth, or by incorrect and inadequate feeding.

Historical Comparisons : The historical review in Table 12 (p. 20) extends this picture by showing that the improvement in the infant mortality rate in New Zealand and in England and Wales has been due mainly to the reduction of deaths from infection and that the present excess in Scotland is due chiefly to a much smaller reduction under this heading. The slower rate of improvement is particularly marked in respect of respiratory infections.

The death rates from the causes special to the neonatal period have been and still are closely similar in Scotland and England and Wales, with the exception of congenital debility. The present superiority of England in respect of neonatal deaths is almost entirely due to reduction of deaths from congenital debility. In the 1–12 months period, only a very small fraction of the Scottish excess is due to tuberculosis, syphilis, convulsions, accident or unknown causes. The excess is explicable as shown in Table 13.

Table 13.—Excess Infant Mortality in Scotland compared with England and Wales

	Excess deaths per 1,000 live births.	Percentage of total excess.
Congenital debility . . .	5·5	26
Whooping cough, measles and other common infections . . .	2·7	13
Respiratory infections . . .	6·5	31
Gastro-intestinal infections . .	3·5	16
	18·2	86

TABLE 11.—CAUSES OF INFANT MORTALITY IN DIFFERENT COUNTRIES

Adapted from Tables XXVI and XXVII (p. 59) of the Text of the Registrar-General's Statistical Review for 1937 (England and Wales). (Scotland has been added)

Country.	Period.	Infant Mortality per 1,000 live births at ages :													
		Under 1 Month.				1–12 months.				0–1 year.					
		Prematurity and Congenital Debility.	Congenital Malformations and Birth Injury.	Other Causes.	All Causes.	Measles, Whooping Cough and Pneumonia.	Diarrhœa and Enteritis.	Other Causes.	All Causes.	Prematurity and Congenital Debility.	Congenital Malformations and Birth Injury.	Measles, Whooping Cough and Pneumonia.	Diarrhœa and Enteritis.	Other Causes.	All Causes.
New Zealand	1932–36	11	6	5	22	3	1	6	10	11	8	4	1	8	32
Australia .	,,	15	6	6	27	5	2	7	14	16	8	6	2	9	41
Holland .	,,	9	7	6	22	7	3	10	20	11	8	7	3	13	42
Norway .	,,	—	—	—	22	—	—	—	22	17	—	8	2	—	44
Switzerland	,,	—	—	—	29	—	—	—	19	13	8	6	5	16	48
Sweden .	1932–35	—	—	—	—	—	—	—	—	—	—	9	2	—	48
U.S.A. .	1932–36	—	8	—	33	8	5	12	25	18	10	10	5	15	58
England and Wales .	,,	18	6	7	31 [1]	11	5	14	30 [1]	20	8	12	6	15	61
Denmark .	,,	16	6	7	29	18	5	17	40	18	9	20	6	16	69
Germany .	,,	26	5	7	38	10	6	17	33	28	7	11	7	18	71
Canada .	,,	19	8	9	36	9	9	17	35	22	10	11	10	18	71
Scotland .	,,	**23**	**6**	**8**	**37**	**17**	**7**	**20**	**44**	**27**	**8**	**19**	**8**	**19**	**81**
Belgium .	,,	—	—	—	—	—	—	—	—	—	—	17	9	—	88
Italy . .	,,	20	2 [2]	15	37	18	30	17	65	22	3 [2]	20	33	24	102
Greece .	,,	12	4 [2]	24	40	18	25	35	78	17	4 [2]	22	28	47	118

[1] Rates for England and Wales are based on mortality under four weeks instead of under one month.
[2] Rates for Italy and Greece probably not comparable with other countries, on account of faulty registration.

TABLE 12—CAUSES OF INFANT DEATH

Deaths under one year per 1000 live births

	All Causes.	Infectious Diseases.												Diseases of Early Infancy.						Convulsions.	Meningitis.	Ill-defined and Unknown.	Violence and Accident.	Other Defined.
		Tuberculosis.	Whooping Cough.	Measles.	Syphilis.	Other Common Infections.	Total Common Infections.	Pneumonia and Bronchitis.	Other Respiratory.	Total Respiratory.	Diarrhœa and Enteritis.	Other Gastro-intestinal.	Total Gastro-intestinal.	Congenital Malformations.	Prematurity.	Congenital Debility.	Injury at Birth.	Other Early Infancy.	Total Early Infancy.					
Scotland.																								
1906–10 . .	112·4	5·3	6·2	3·3	1·3	2·4	18·5	20·7	1·0	21·7	13·1	3·6	16·7	4·9	18·0	12·6	1·3	1·6	38·4	5·1	3·0	4·5	1·9	2·6
1911–15 . .	112·8	4·1	7·0	3·9	1·3	1·8	18·1	21·1	1·5	22·6	12·7	3·3	16·0	4·2	19·7	15·2	3·2		42·3	4·8	2·8	1·8	1·7	2·7
1916–20 . .	99·0	2·6	4·9	2·7	1·4	2·0	13·6	19·8	1·3	21·1	9·3	2·8	12·1	4·0	18·9	14·8	2·7		40·4	4·6	2·4	1·4	1·1	2·3
1921–25 . .	91·7	2·2	5·7	2·8	0·9	2·6	14·2	18·8	1·1	19·9	7·3	2·1	9·4	4·1	18·0	14·2	0·6	2·2	39·1	3·6	1·7	0·6	1·0	2·2
1926–30 . .	85·4	1·7	3·9	2·1	0·5	2·8	11·0	19·2	0·9	20·1	6·3	1·6	7·9	4·6	17·6	12·1	1·4	2·0	37·7	3·2	1·4	0·7	1·1	2·3
1931–35 . .	80·8	1·3	3·5	1·8	0·3	2·6	9·5	17·4	0·7	18·1	7·2	1·2	8·4	5·4	18·2	9·0	2·2	3·1	37·9	2·2	1·0	0·4	1·1	2·2
1936–38 . .	77·4	1·0	2·6	1·4	0·2	2·0	7·2	16·4	0·8	17·2	8·4	1·1	9·5	6·2	16·9	7·6	3·0	3·3	37·0	1·7	0·9	0·3	1·3	2·3
England and Wales.																								
1906–10 . .	117·1	4·4	4·6	2·4	1·2	1·5	14·1	19·9	0·9	20·8	17·8	2·7	20·5	4·9	19·9	15·0	1·0	1·7	42·5	10·6	1·8	2·4	2·3	2·1
1911–15 . .	109·6	3·1	4·1	2·9	1·4	—	—	19·2	0·7	19·9	19·3	—	—	3·8	19·7	12·7	1·1	—	—	8·8	1·3	—	—	—
1916–20 . .	90·0	2·0	3·0	1·8	1·7	—	—	18·6	0·5	19·1	9·3	—	—	4·0	19·3	9·6	1·1	—	—	6·8	0·9	—	—	—
1921–25 . .	76·1	1·4	2·9	1·3	1·1	1·5	8·2	16·1	0·4	16·5	8·1	1·9	10·0	4·2	18·5	6·2	1·4	2·4	32·7	4·4	0·7	0·1	1·3	2·2
1926–30 . .	67·9	1·1	2·6	1·2	0·7	1·7	7·3	14·3	0·3	14·6	6·5	1·4	7·9	4·9	18·0	4·1	1·9	2·3	31·2	2·8	0·5	0·1	1·3	2·2
1931–35 . .	62·2	0·8	1·7	0·9	0·4	1·7	5·5	12·2	0·2	12·4	5·4	1·2	6·6	5·9	18·0	2·9	2·3	3·0	32·1	1·9	0·4	0·1	1·2	2·0
1936–38 . .	56·2	0·6	1·4	0·7	0·2	1·1	4·0	10·5	0·1	10·6	5·1	0·9	6·0	6·1	16·4	2·1	2·5	3·4	30·5	1·3	0·3	0·0	1·1	2·4
New Zealand.																								
1907–11 . .	68·5	1·3			5·9		7·2	—	—	7·6	—	—	15·5	1·9		26·7			28·6	3·3		6·3		
1912–16 . .	52·5	0·6			3·6		4·2	—	—	5·1	—	—	7·4	3·9[1]		26·2			30·1	2·2		3·5		
1917–21 . .	48·1	0·5			3·2		3·7	—	—	4·7	—	—	4·5	4·3		26·1			30·4	1·9		2·9		
1922–26 . .	41·1	0·4			1·8		2·2	—	—	4·3	—	—	2·8	4·8		22·4			27·2	1·3		3·3		
1927–31 . .	35·2	0·3			1·5		1·8	—	—	3·7	—	—	1·7	5·0		19·4			24·4	0·5		3·1		
1932–36 . .	31·7	0·2			1·5		1·7	—	—	3·3	—	—	1·2	5·0		17·5			22·5	0·6		2·4		
1937–39 . .	32·7	0·2			1·0		1·2	—	—	3·4	—	—	1·2	5·9		17·8			23·7	0·2		3·0		

[1] The registration of stillbirths was made compulsory in 1913, and the registration of live-born infants and neonatal deaths therefore improved.

Occupational Mortality : Table 14 shows the causes of death by social class as distributed by the Registrar-General.

There is a steady rise from class I to class V in all causes shown except congenital malformations and injury at birth. The rise is greatest for infectious disease. Whooping-cough mortality in class V is nine times that in class I ; for bronchitis and pneumonia it is seven times and for tuberculosis, diarrhœa and enteritis and other common infections, four times. In class V the recorded prematurity rate is not quite double, and the congenital debility rate not quite three times, that of class I.

Comparison of these data with those in Table 12 shows, in respect of causes, that only the upper classes in England and Wales are comparable with New Zealand, and that Scotland, as a whole, approximates to the lowest occupational class in England and Wales.

Table 14.—Mortality of Legitimate Infants according to Social Class of Father, England and Wales, 1930–32

Cause of death.	Infant mortality rates per 1,000 legitimate live births.						Mortality of children of specified class per cent. of that of all legitimate children.				
	All Classes.	I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
Whooping Cough . .	1·8	0·3	1·0	1·6	2·1	2·7	17	56	89	117	150
T.B. All forms . .	1·0	0·3	0·6	0·9	1·1	1·3	30	60	90	110	130
Other Common Infections	3·3	1·1	1·7	2·9	3·6	4·9	33	52	88	109	148
Bronchitis and Pneumonia	12·7	2·8	6·1	11·2	14·5	18·8	22	48	88	114	148
Diarrhœa and Enteritis .	5·2	2·0	2·6	4·6	5·4	7·9	38	50	88	104	152
Premature Birth . .	17·3	10·5	14·4	16·8	18·6	19·6	61	83	97	108	113
Congenital Debility .	3·0	1·4	2·2	2·9	3·3	3·8	47	73	97	110	127
Injury at Birth . .	2·1	2·3	2·5	2·1	2·0	2·0	110	119	100	95	95
Congenital malformations	5·5	5·0	5·4	5·6	5·7	5·4	91	98	102	104	98
Convulsions . . .	2·1	1·3	1·7	2·0	2·6	2·3	62	81	95	124	110
Accident . . .	0·8	0·6	0·8	0·7	0·9	1·0	75	100	88	113	125
Other Causes . .	6·8	5·1	6·0	6·3	7·0	7·4	75	88	93	103	109
All Causes . . .	61·6	32·7	45·0	57·6	66·8	77·1	53	73	94	108	125

The Importance of Prematurity : In almost all records prematurity is the most frequent single stated cause of death in the first month. Even so, the records greatly understate the importance of prematurity because, usually, if it is possible to assign any other cause, a death will not be ascribed to prematurity. Yet the cause specified may be closely related to the prematurity. For instance, congenital debility and malformations may be simple expressions of incomplete development, and injury at birth is more likely to occur to the premature infant because its tissues are more fragile. An attempt has therefore been made to assess the effect of prematurity on infant mortality. Only studies in which premature births are distinguished by a birth weight of less than 2,500 g. ($5\frac{1}{2}$ lb.) have been considered.

Two studies of the incidence and effect of prematurity in general populations have been found. One relates to mortality in New York State, excluding New York City, in 1936 ; the other to mortality in New York City in 1939. The former includes both white and coloured infants since these were not separately stated. From the latter the data for births of white infants have been extracted.

The data are presented in Table 15. The incidence of prematurity in Chicago in 1940 was 6·5 per cent. but the data have not been presented in a form to make assessment of its effect possible.

The general neonatal rates in New York State and City are low in comparison with the data in Table 3. In both cases the rate in full-time infants is less than half that in the entire group. Prematurity has more than doubled neonatal mortality.

Table 15.—Effect of Prematurity on Infant Mortality

	No. of live births.	Per cent. premature.	Neonatal mortality rate.		
			Premature, per 1,000 premature births.	Full-time, per 1,000 full-time births.	Total.
New York State, 1936. (Yerushalmy, 1938).					
All births . .	82,140	4·3	389	15·2	31·2
New York City, 1939. (Duffield *et al.*, 1940).					
White : Single born .	90,331	6·0	179	10·1	20·1
,, Plural born .	1,818	56·6 [1]	193	25·3	120·5
,, All . .	92,149	7·0	181	10·2	22·1
Chicago, 1940. (Bundesen).					
All births . .	50,931	6·5	—	—	—

[1] This figure is not strictly comparable with that for single births. Twins weigh on the average less than single born infants and when the same weight standard is used to assess prematurity, the proportion of twins among prematures is overassessed. On the other hand, the inclusion or exclusion of twins makes little difference to the final result.

Negro infants also appear on the average to weigh less than white. For this reason data for white infants only have been presented where it is possible to separate the two. Where they have not been separated, the incidence of prematurity would have been *less* if white infants only had been included.

Similar evidence is afforded by hospital data. No close correspondence in detail would be expected between the data for a community and those for a hospital, because a hospital population is seldom, if ever, a cross-section of the area it serves. Hospital records will be weighted by an excess of the poor, and by complicated pregnancies and difficult labours. It might be expected, therefore, that premature labours would show an excess in hospital cases but the data for Chicago Lying-in Hospital, with 5·6 per cent. prematurity, taken with the 1940 figure of 6·5 per cent. for Chicago as a whole, do not support this view. In any case, the records are instructive. Illustrative recent data are presented in Table 16. A general estimate for American hospitals of 5 to 6 per cent. is given in Appendix 3 (p. 80).

Peckham's survey covered forty years. He stated that there had been no significant change in that time. The rates are relatively low. Flax *et al.* do not give data for full-time births but the mortality of premature infants is high. The two Scottish hospitals show higher prematurity rates than the American hospitals and higher mortality rates than Baltimore. In these prematurity has, in the one case, more than doubled and, in the other, more than trebled the death rate. Mortality in Baltimore was less than doubled by prematurity.

The incidence of 7 per cent. prematurity quoted from Anderson's study at Cincinnati General Hospital applies only to single white live births since their twin births were not distinguished by race.

Table 16.—Effect of Prematurity on Neonatal Mortality. Hospital Data. White Infants Only, except Chicago.

	No. of live births.	Per cent. premature.	Neonatal mortality rate.		
			Premature, per 1,000 premature births.	Full-time, per 1,000 full-time births.	Total.
Johns Hopkins Hospital, Baltimore, 1896–1936 (Peckham, 1938.)	17,968	5·9	207	15·9	27·2
Chicago Lying-in Hospital, 1931–1938 . (Potter and Adair, 1938.)	17,326	5·6	—	—	—
	(Premature only)				
New Orleans Charity Hospital, 1937–1938 .	373	—	786	—	—
1939–1940 .	486	—	500	—	—
(Flax *et al.*, 1942.)					
Cincinnati General Hospital, One year . (Anderson *et al.*, 1941.)	1,460	7·0	—	—	—
Edinburgh Maternity Hospital, 1939–1940 . (McNeil, 1942.)	4,886	9·1	314	21·8	48·3
Aberdeen Maternity Hospital, 1941–1942 . (Baird, unpublished.)	3,156	11·1	391	18·9	60·2

Both Peckham and Flax show that the heavier a premature child is at birth, the better are its chances of survival. Peckham's data are discussed further below in connection with stillbirths, and illustrated in Fig. 5, p. 42.

The following table (Table 17) compares the distribution of birth weights of premature live-born infants at Aberdeen and Edinburgh Maternity Hospitals,

Table 17.—Percentage Distribution of Premature Births by Weight

All prematures.	Aberdeen 1938–1942	Edinburgh 1939–1940	Cincinnati (One year).	Baltimore 1896–1936	
Less than 3 lb.	13·5 } 19·7	11·6 } 19·3	5·9 } 8·8	5·7 } 12·3	Less than 1400 g.
3–3½ lb. .	6·2 }	7·7 }	2·9 }	6·6 }	1400–1600 g.
3½–4 lb. .	7·8 } 23·3	11·2 } 25·3	2·0 } 12·8	9·2 } 18·5	1600–1800 g.
4–4½ lb. .	15·5 }	14·1 }	10·8 }	9·3 }	1800–2000 g.
4½–5 lb. .	18·8 } 57·0	19·6 } 55·4	28·4 } 78·4	34·1 } 69·1	2000–2300 g.
5–5½ lb. .	38·2 }	35·8 }	50·0 }	35·0 }	2300–2500 g.

Percentage Distribution of Neonatal Deaths of Premature Infants by Birth-Weight

Less than 3 lb.	37·0 } 52·9	34·8 } 51·5		20·8 } 40·6	Less than 1400 g.
3–3½ lb. .	15·9 }	16·7 }		19·8 }	1400–1600 g.
3½–4 lb. .	13·2 } 28·0	15·9 } 30·4		18·2 } 29·1	1600–1800 g.
4–4½ lb. .	14·8 }	14·5 }		10·9 }	1800–2000 g.
4½–5 lb. .	9·5 } 19·0	10·9 } 18.1		18·2 } 30·2	2000–2300 g.
5–5½ lb. .	9·5 }	7.2 }		12·0 }	2300–2500 g.

with that at Cincinnati General Hospital (Anderson *et al.*, 1941) and the Johns Hopkins Hospital, Baltimore (Peckham, 1938) and the distribution of the birth weights of premature infants dying in the first month of life in Aberdeen, Edinburgh and Baltimore. Only white single births are included in the American data.

It will be seen that, in both sets of data, Aberdeen and Edinburgh show a smaller proportion of the higher birth-weights and more of the lesser weights than the American hospitals. This, taken in conjunction with the higher incidence of prematurity in the Scottish hospitals as compared with the American (Table 16), is at least sufficient to suggest that the general incidence of prematurity in Scotland is higher than in the United States.

Flax *et al.* present tables showing causes of death by weight groups, from which it appears that in infants of less than 1500 g. (3·3 lb.) at birth, 83 per cent. of deaths are due to atelectasis, cranial injury or prematurity without other assignable cause. Above this weight an abrupt change occurs. In infants weighing from 1500 g. to 2500 g. ($5\frac{1}{2}$ lb.) only 38 per cent. of deaths are due to these three causes together and 42 per cent. to broncho-pneumonia and diarrhœa alone or 50 per cent. to infection (excluding syphilis). The reduction in deaths shown in Table 16 in the second period coincided with improvements in supervision and nursing care in 1939 with provision of breast milk for the smallest babies, and the opening early in 1940 of a special unit for premature infants with isolation for the sick.

The distribution of causes of deaths in this series is closely similar to that reported for Edinburgh Maternity Hospital by McNeil, who stresses the need for better control of infections. The data are compared in Table 18.

Table 18.—Causes of Death in Premature Live-Born Infants
Per Cent. of Deaths

Edinburgh, 1939–1940 (McNeil, 1942).		New Orleans, 1937–1940 (Flax *et al.*, 1942).	
Asphyxia	36·9	Atelectasis	24·3
Intracranial hæmorrhage	15·4	Cranial injury	11·0
No cause found	16·2	Prematurity only	22·1
Infection	23·1	Infection	27·5
All others	8·4	All others	15·1
	100·0		100·0

Further evidence, both of the importance of birth-weight and of the possible reduction of infection comes from Aberdeen Maternity Hospital, with a different classification of deaths. (Table 19.)

The largest group is the first. It includes 74 per cent. of the deaths. Most of the infants died within three days of birth and most of them were very small. These deaths must be attributed to prematurity alone.

In the last group, 6·6 per cent. of the total, the deaths are in no wise due to post-natal environment. In the second group it seems likely that most of the deaths were due simply to prematurity but there may have been infection. In the third group, 14·6 per cent. of the total, most of the infants were heavier and the deaths may have been avoidable. Of the twenty deaths, sixteen occurred in 1941 and only four in 1942 when increased nursery accommodation and staff were provided to deal with ill babies.

Taken with Flax's data, this suggests that, with the most careful isolation and nursing, the death rate from infection in premature babies can be reduced. But, even if all the deaths from infection were eliminated, the result would still be unsatisfactory. For instance, in the Aberdeen data, the complete elimination of deaths from infection, assuming that the infants would then survive, would

reduce the neonatal death rate in prematures only from 391 to 334 per thousand premature births, and the general neonatal rate from 60·2 to 53·9. There would remain the much larger problem of eliminating prematurity, by which the general rate could be reduced to one-third, without any change in the full-time death rate.

Table 19.—Cause of Death in 137 Premature Infants, Aberdeen Maternity Hospital, 1941–1942

Weight in lb.	5½–5	5–4½	4½–4	4–3½	3½–3	3 or less.	Totals.
Weakness.							
Lived less than 24 hours.	5	5	7	5	15	29	66
,, ,, ,, 3 days .	1	—	4	2	3	15	25
,, more than 3 days but feeble from birth .	1	1	2	—	4	3	11
Total .	7	6	13	7	22	47	102
Doubtful.							
Slow feeding and lethargy (Immaturity of digestive system and/or infection).	1	—	—	1	1	3	6
Infection.							
Gastro-enteritis . .	1	3	5	1	—	—	10
Pneumonia . . .	1	—	1	—	1	1	4
Skin infection . .	—	1	4	—	1	—	6
Total .	2	4	10	1	2	1	20
Other causes.							
Erythroblastosis . .	4	—	—	1	—	—	5
Deformity . . .	2	—	—	1	—	—	3
Congenital syphilis .	—	—	—	—	1	—	1
Total .	6	—	—	2	1	—	9

From time to time the conventional certification of infant deaths has been criticised as concealing causes of death (Bundesen *et al.*, 1937 ; Spence and Miller, 1941) and therefore providing an unsatisfactory basis for improvement.

Bundesen and his co-workers made a careful investigation into the causes of infant deaths, up to fifteen days of age, in Chicago in 1936. There were 1123 such deaths (61 per cent. of the total 1,848 infant deaths), and of these 681 were deaths of premature infants. Satisfactory post-mortem examinations were made of more than a third of these. During the following four years an intensive campaign to reduce the mortality of premature infants was instituted (Hess, 1936 ; Bundesen *et al.*, 1936–38). Approximate comparison of the 1936 data with the corresponding data for 1940 (Report of Board of Health for the year 1940) indicates that the death-rate of premature infants under fifteen days fell by about 10 per cent. during this period, while the general infant mortality rate fell by 25 per cent. This is, in itself, no insignificant result but it is small compared to the reduction of mortality that might be achieved by the elimination of premature birth.

Spence and Miller approached the problem from a different angle, attempting

by special inquiry to throw light on the causes of infant deaths over a year in Newcastle. The greatest value of this survey possibly lies in the attempt to discover the causes of the premature onset of labour.

There were 272 deaths investigated out of a total of 274. Of these, 78 were of premature infants born to 73 mothers. The prematurity was attributed to twin pregnancy in 15 cases. It was associated with toxæmia in 13, with rheumatic heart disease in 2 and with infection in 3. There was a history of repeated premature birth or miscarriage in 4 and Cæsarean section was necessary in 2. There were 34 cases left with no obvious associated abnormality.

These findings differ little from other attempts to associate prematurity with pathological conditions in the mother. In the surveys of Clifford (1934), Breese (1938), Potter and Adair (1938), the review by Anderson and Lyon (1939) and the findings of Anderson, Brown and Lyon (1941), about half of the premature births investigated were associated with toxæmia, hæmorrhage or premature rupture of membranes, and more than 40 per cent. occurred without any obvious maternal complication. The associations were mostly considered insignificant and these investigations therefore apparently contribute little or nothing to a solution of the problem of premature birth. Even if the associations had been definite the problem would still be unsolved because the causes of the toxæmias, hæmorrhages, and premature rupture of the membranes would still be unknown.

Anderson, Brown and Lyon carried their analysis further. Of the 2,373 births investigated, 9·7 per cent. of the prematures were illegitimate and only 4·6 per cent. of the full-term infants ; 12·6 per cent. of the mothers of premature infants complained of excessive fatigue and only 6·4 per cent. of the mothers of heavier infants. An assessment was made, in terms of number of visits, of the adequacy of antental care. Care was judged inadequate in 51·9 per cent. of the mothers of premature and in 38·4 per cent. of the mothers of mature infants.

No account was taken of diet beyond establishing that there was a correlation between low maternal and low infant birth weight, which might be associated with diet. Such a correlation would, however, be found in general even if all the mothers were equally well nourished. Since in fact this hospital population was all from " the lower economic strata " in which much malnutrition would be expected, the most promising line of investigation would have been a comparison of the diets of mothers of premature and mature infants (cf. below, p. 48, Graham and Cameron).

The known facts concerning the relationship of diet to toxæmia, premature birth and the viability of the young are summarised in Part III.

In Table 14, p. 21, the registered mortality attributed to premature birth in class V is nearly twice that in class I. From what has been said above and from Table 27, p. 36 below, this social class difference appears likely to be due chiefly to a greater incidence of prematurity among the poor.

The Importance of Infections after One Month of Age : The data assembled above show the overriding importance of normal development of the child for survival to one month of age, and of infection as a cause of death after one month.

Epidemics of infectious disease in young children vary greatly in extent and severity, particularly those that occur in the winter months. Their extent and severity may be said to depend on (*a*) the virulence and infectivity of the infecting organisms, (*b*) the exposure and (*c*) the powers of resistance of those exposed to attack. The spread of infection, particularly droplet infection, is most frequent in overcrowded houses in congested areas of towns and cities (see also below, p. 29). There is evidence that the severity of the major epidemic diseases of young children has shown a general decline in recent years but this improvement has not been fully manifested among the infant and child populations where housing conditions are poor and exposure most free and frequent.

The periodic mortality from the main epidemic diseases accounts for part, but not all, of the excess in areas where the infant death rate is high. In addition to this, deaths from respiratory and gastro-intestinal disease show a continuously high rate in such areas. Housing conditions are no doubt partly respon-

sible, but, in this class of infections, the powers of resistance of the subject may be of as great importance. The importance of the correct feeding of infants for resistance to such infective disease will be discussed in Part III.

Infections in Maternity Hospitals: It has been shown in Table 11, p. 19, that, according to the certification of causes of deaths in the first month in Scotland, about one-quarter are due to infection. Some authorities consider that this is an underestimate and that the true mortality from infections cannot be stated without post-mortem examination of all infants dying. It is a matter of greater immediate concern that epidemic and endemic infections in some maternity hospitals should be responsible for a fair proportion of these deaths. In a consecutive series of 225 post-mortem examinations of infants dying during the first month in the Maternity Pavilion, Royal Edinburgh Infirmary (McNeil, 1942), 27 per cent. of the deaths were judged to be due to infection.

The infections responsible for these neonatal deaths in maternity hospitals are of four types: epidemic diarrhœa, *staphylococcal* disease, *Bacillus coli* infections and thrush. Craig (1936) and Henderson (1943) have described outbreaks of enteritis (acute alimentary catarrh) in an Edinburgh hospital in which no organism of the dysenteric group was isolated. Almost all of the infants affected were bottle fed. Graham (1939) described one in Glasgow due to *B. enteritidis* (Gaertner).

Similar outbreaks have been described in English hospitals by Ormiston (1941) and in American hospitals by Rice *et al.* (1937) and Best (1938). These American reports were followed by administrative action by which diarrhœa of the new-born in institutions was made notifiable and special regulations designed to prevent its occurrence. In Ormiston's series, as in some of the American outbreaks, none of the usual dysentery organisms was responsible (Crowley *et al.*, 1941).*

In an extensive study of fatal pneumonia in the new-born, Macgregor (1939) has shown that *staphylococcal* and *B. coli* infections are common. Pneumonia due to *B. coli* is extremely rare at any later age. Craig (1936) in a series of 21 cases of neonatal meningitis found *B. coli* to be the infecting organism in 10 and *Staphylococcus* in 5.

Ludlam and Henderson (1942) studied the incidence of thrush in infants in a Scottish maternity hospital and found 163 cases among 2,540 infants that survived for more than forty-eight hours, an incidence of 6·4 per cent. The condition was relatively much more frequent in premature than in full-term infants. The incidence increased with length of stay in hospital and the proportion of infants infected was much greater than the proportion developing lesions while in hospital. Over a period of four years, twenty cases of ulceration of the œsophagus, due to thrush, were found at post-mortem examination and the ulceration was regarded as the cause of death in thirteen, i.e. in 4·3 per cent. of deaths after forty-eight hours in hospital. Three-fifths of the fatal infections were in premature infants. Other publications are cited by Ludlam and Henderson, which show a similar high incidence in other maternity hospitals in England and elsewhere.

It will be seen later, Part IV, pp. 64–66, that maternity hospitals, especially the voluntary hospitals, in Scotland, are overcrowded. This is probably partly responsible for the high incidence of these infections. Since the tendency is towards an increase in the proportion of births in institutions, the problem is clearly one that calls for immediate investigation and for effective countermeasures.

* A more recent paper on outbreaks in Canadian Hospitals (McClure, 1943) describes the isolation of the same strains of hæmolytic colon organisms from the fæces of infants and nurses and from tables and feeding bottles.

CHAPTER 4—ASSOCIATIONS WITH HIGH INFANT MORTALITY RATE

Climate : Titmuss states in his most recent book, *Birth, Poverty and Wealth,* that if it is a fact that climate has a significant effect on infant mortality we should expect to find that infants in class I, as distinguished by the Registrar-General, in the North, would have a higher death rate than in the South. But this is not the case. For instance, Lancashire and Cheshire, with a damp climate and heavy smoke belt, have a lower class I rate than the South West of England and South Wales with a more favourable climate. It will be remembered from Table I that Iceland and Norway, with much more severe winter climates than either England and Wales or Scotland, have much lower infant mortality rates. Fig. 2 and the data in Appendix 1, Table 52, show that the islands of Orkney and Shetland and some of the Highland Counties have the lowest infant mortality rates in Scotland. If, therefore, climate has any important effect on infant mortality, as measured by annual death rates, it is more than offset by other influences. On the other hand, the seasonal incidence of mortality, which for some years has been highest in the first quarter of the year, suggests that winter weather does affect the susceptibility to and the severity of infections and especially respiratory infections. This effect would be most likely to appear where housing and general environment are poorest.

Economic and Social Conditions : It is apparent from the data presented in Chapters 2 and 3 that adverse economic and social conditions have a direct effect on the infant's chances of survival. But there is in Great Britain no detailed investigation of which particular factors in this complex are the most important. Such data as are available in Scotland and England and Wales on the incidence of low incomes, unemployment, overcrowding and high birth rates are presented here.

Low Incomes : In 1936 an investigation by Orr into income distribution in Great Britain showed that 10 per cent. of the population had an income per head of less than 10s. a week, which meant that, on the average, only 4s. a week was spent on food. A similar investigation in Scotland in 1936 showed about twice as high a proportion of the population in this income group.

Overcrowding : In the housing survey of 1935, the percentage of families overcrowded in Scotland was 22·6 ; in England and Wales it was 3·8. Table 20 shows the overcrowding in the twenty-four large burghs of Scotland. The mortality between one and twelve months is presented rather than total infant mortality since, as has been shown above, it tends to be more sensitive to poor environmental conditions.

The percentages range from 11·3 in Inverness to 44·8 in Coatbridge, with an average of 26·2. In English cities the overcrowding is of an entirely different order. Of the twenty-three in Table 8, only Sunderland, with a percentage of 20·6 and Newcastle and Gateshead with 12·0, are in any way comparable with the Scottish cities. The remainder vary from 0·9 to 8·4 and the average is 4·5.

From Table 20 it can be seen that there is a correlation which is statistically significant between mortality and overcrowding. The average overcrowding is 26·2 per cent. Ten out of the first twelve cities in order of mortality have a higher percentage than this ; only two out of the last twelve. The average overcrowding among the first twelve is 33·1 per cent. ; among the last twelve it is 19·3 per cent.

It must be remembered that these percentages represent families overcrowded. The proportion of people living under overcrowded conditions is naturally higher. The standard used in the survey was not over high ; the permitted number of " persons " to each room of a " house " was two, a child between one and ten years of age being only half a " person " and an infant not a " person " at all. The standard does not take into account overcrowding per

building as distinct from overcrowding per " house " and does not therefore give an adequate idea of the massing of humanity in tenements that is a feature of Scottish slums. The most crowded houses will also usually be the oldest and most dilapidated, with decaying woodwork and pest infested, sometimes without water closet, indoor water supply or even the most meagre larder accommodation.

Table 20.—Mortality between 1 and 12 Months, Overcrowding and Unemployment in the 24 Large Burghs of Scotland

	Mortality 1–12 months 1934–38.	Percentage families overcrowded 1935.	Percentage insured population unemployed 1934–36.[1]
Glasgow	59	29·1	21·3
Greenock	57	33·7	26·3
Dumfries	51	14·2	11·3
Coatbridge	51	44·8	26·5
Paisley	51	31·7	13·5
Hamilton	46	38·6	18·1
Port Glasgow	46	42·1	[2]
Motherwell and Wishaw	43	40·5	22·0
Airdrie	43	29·8	20·1
Clydebank	43	40·9	19·7
Dumbarton	43	29·0	22·1
Kilmarnock	42	23·1	13·4
Ayr	42	26·3	14·5
Dundee	41	23·9	22·1
Aberdeen	41	22·1	12·8
Perth	39	12·7	11·1
Inverness	38	11·3	11·9
Rutherglen	35	30·1	13·5
Arbroath	34	16·1	12·8
Stirling	31	14·4	12·8
Edinburgh	31	17·2	11·1
Falkirk	28	23·8	10·9
Dunfermline	27	15·0	11·3
Kirkcaldy	24	18·9	12·4

[1] No data for the percentages of the insured population unemployed are available. Numbers of unemployed were obtained by courtesy of the Ministry of Labour and National Service. Numbers of the insured population were calculated from p. 76 of the Seventh Report on Incapacitating Sickness in the Insured Population. The resulting percentages are not strictly accurate, but the errors are small.

[2] Figure not available.

The very great difference in social class mortality from whooping cough shown in Table 14 is certainly due, in large part, to overcrowding in poor families where it is practically impossible to isolate the infected. An investigation by Halliday (1928) in Glasgow showed how tenements contribute to the spread of measles among young children. In schools serving tenement areas twice as many children had measles by the age of five as in schools serving a middle-class housing estate. The case mortality of children under two years is from ten to twenty times that of children of school age. The same must be true of other epidemic infections. Not only so, but overcrowding must favour the spread of all respiratory infection and the poor standard of sanitation and domestic water supplies will greatly increase the risk of gastro-intestinal disease. In this way infants are subjected to repeated or mass infections of the most varied type.

Unemployment : The unemployment rate also is higher in Scotland than in Great Britain as a whole, although Wales and North England show higher percentages (Table 21).

Table 21.—Percentage of Insured Population Unemployed

	1934	1935	1936	1937	1938
GREAT BRITAIN . .	16·6	15·3	12·9	10·6	12·6
Scotland . . .	23·1	21·3	18·7	15·9	16·3
Wales . . .	32·3	31·2	29·4	22·3	24·7
N. England . .	22·1	20·7	22·9	17·9	18·3
N.E. England . .			13·5	11·0	13·5
N.W. England . .	20·8	19·7	17·0	14·0	17·8
Midlands . . .	12·9	11·2	9·2	7·2	10·2
S.W. England . .	13·1	11·6	9·4	7·8	8·1
S.E. England (excluding London) . .	8·7	8·1	7·2	6·7	8·0
London . . .	9·2	8·5	7·0	6·3	8·0

A high percentage of unemployment in any district probably increases poverty both directly and indirectly by depressing wage rates, and the depressing effect of economic insecurity will hardly be conducive to the careful rearing of children.

Table 20 gives the percentage of the insured population unemployed in twenty-three of the twenty-four large burghs of Scotland, 1934–36. A high unemployment rate was then correlated with a high mortality rate between one and twelve months. The correlation is statistically significant. In the first ten burghs arranged in order of mortality the average unemployment rate was 20·1 per cent.; in the last ten 15·7 per cent. The average rate was 16·2 per cent. Eight out of the first ten had a higher rate than this and one of the last ten. The Scottish cities had a much higher unemployment rate than London. Percentage rates are not available for other English cities.

Birth Rate : In Great Britain, a relatively high birth rate is unfortunately associated with poverty and poor surroundings. In 1930–32, in England and Wales, the number of legitimate births per 1,000 married women aged 15 to 44 was 95 in class I and 152 in class V. In 1938 the figure for the whole of England and Wales was 112 and for Scotland 152, the same as class V in England in 1932. The rate for class V in Scotland would be much above that of Scotland as a whole.

This means that poor mothers in Scotland begin having children at a relatively early age and have large and closely spaced families. No analysis on a large scale has been made of the effect of maternal age and birth order on infant mortality, but such local inquiries as have been undertaken (e.g. Elderton, 1925; Yerushalmy, 1938, 1940; Burns, 1942) have shown that very early and very late child-bearing give high mortality rates. The findings suggest that at least neonatal mortality will be related in much the same way as stillbirths to age and parity. The relationship for stillbirths is shown for England and Wales in Table 33, p. 43. It is further shown in Table 35 that, as far as expectation of live births is concerned, the age and parity distribution of Scottish births is highly favourable. Hence it may be tentatively concluded that early breeding and large families would not increase the expectation of neonatal mortality among the poor in Scotland. But the close spacing of the family may affect later mortality. Woodbury (1925) has shown that when there is an interval of only one year between births, the death rate is 50 per cent. higher than when the interval is two years or more. When a new baby is started before the first is a year old, the chances of death of the first baby are multiplied by three.

Children are in themselves a source of poverty since young wage-earners

have low wage rates not adjusted to family needs. The younger the parents and the more closely spaced the family, the greater will be the poverty. On the other hand, those who postpone child-bearing until they " can afford it " will then have a lower natural fertility than those who start reproduction at an early age. This is recognised in clinical practice to be so, and has recently been demonstrated experimentally in animals. Those who begin late will therefore tend to have fewer children, apart from voluntary restriction, than those of similar age who begin early. The postponement of child-bearing may increase the risk of child-birth but this increase appears to be more than offset by the advantages of better economic status, including the possibility of securing better medical and nursing care.

Declining birth rates in recent years have caused additional attention to be directed to problems of infant death. The birth rates in England and Wales and Scotland in 1938 of 15·1 and 17·7 represent net reproduction rates * of 0·81 and 0·96. Hence Scotland as a whole and class V in England and Wales are not quite maintaining themselves ; England and Wales as a whole is far from doing so. It is a mistake, therefore, to talk of a high birth rate for any area or class in Great Britain, except perhaps the Scottish poor. The loss of infant life is, therefore, all the more important. But it is also certain that a high birth rate need not be associated with high infant mortality. In Holland, where in 1938 the birth rate was 20·7, giving a reproduction rate of well over 1, the infant mortality rate was only 37. Further, the birth rates of New Zealand, Australia, Norway and Sweden appear to show a definite rise above the low values reached between 1933 and 1935. In New Zealand, for instance, the birth rate rose from 16·1 to 22·8 between 1935 and 1941, while the infant mortality rate fell from 32·3 to 29·7.

Illegitimacy : In Scotland, illegitimate births form a higher percentage of the total, and the excess of deaths in illegitimate children is greater than in England and Wales (Table 22).

Table 22.—Illegitimate Live Births and Deaths

	Scotland.			England and Wales.		
	Illegitimate live births : per cent. of total.	Infant mortality rate.		Illegitimate live births : per cent. of total.	Infant mortality rate.	
		Legitimate.	Illegitimate.		Legitimate.	Illegitimate.
1936	6·5	80	120	4·1	57	88
1937	6·2	78	122	4·1	56	88
1938	6·2	67	109	4·2	51	81
1939	6·0	67	96	4·2	49	90
1940	5·9	76	120	4·3	55	82

There was an average difference, over the five years, between the legitimate death rates of 20 and between the illegitimate rates of 26. In Scotland the average excess mortality in illegitimate children was 38 ; in England 32. Thus the high death rate of illegitimate infants is a serious problem in itself, but it contributes little to the total mortality, and reduction to the same level as that for legitimate infants would reduce total mortality by only 2 per 1000.

Poverty and overcrowding bear more hardly on the illegitimate child. Illegitimate births include a higher percentage of first births and probably a much higher percentage of mothers in employment and unable to give the child the necessary care.

Yet, given good conditions, the illegitimate death rate need not be high. In

* The Gross Reproduction Rate is a measure of the number of girl babies produced per woman of the present generation. If the rate is unity, the women are just being replaced. The Net Reproduction Rate takes into account the death rates at various ages and is a better measure of the expected size of the next generation of women.

Oslo in 1935, " foster children " under the control of the Department of Health, mostly illegitimate infants, had a mortality of only 10 per 1,000. In Birmingham in 1938, a plan was made to improve the standards of care for the unmarried mother and her child. Three special workers were appointed. There are now six homes for unmarried mothers, run by voluntary societies, to which the Local Authority, through its Maternity and Child Welfare Committee, can send mothers, either before or after confinement. The Committee pays the charges. There is also a service of foster mothers, under the control of the Health Department and paid by the Local Authority who recover the whole or part of the cost from the mother. Good results seem to be appearing as the following table shows.

	1938	1939	1940	1941
Legitimate death rate . . .	60	58	70	69
Illegitimate death rate . .	80	94	69	75

In Scotland, too, illegitimate and boarded-out children are subject to divided supervision in a way that does not obtain in England and Wales. The Infant Life Protection Officer in Scotland is the Public Assistance Officer. In England and Wales he is usually the Medical Officer of Health. The Health Visitor is the most suitable person to act as Infant Life Protection Visitor and she should be responsible to the Medical Officer of Health, whereas in Scotland she is in fact responsible to the Public Assistance Officer for this part of her work. In many instances, the Public Assistance Departments have their own officials who act also as Infant Life Protection Visitors and whose views from time to time are likely to, and in fact do, differ from those of the Health Visitors as to what is best for the child.

In the same way, too, the administration of the sections of the Adoption Acts referring to the duties of local authorities should be solely in the hands of the Clerk to the Authority and the Medical Officer of Health. This applies particularly to section 7 of the Adoption of Children (Regulation) Act, 1939.

SUMMARY OF PART ONE

1. The infant mortality rate in Scotland compares unfavourably with that in other parts of the English-speaking world and all other countries in the West of Europe except Spain and Portugal.
2. All countries show a decline in their infant mortality rate over a period of years, but in Scotland the rate of decline has been slow. England and Wales and New Zealand have reduced their infant death rates by two-thirds ; Scotland by only one-third.
3. The causes of infant mortality can be most conveniently analysed in two parts, i.e. deaths under one month of age and deaths between one month and twelve months. Scotland would need to reduce her neonatal mortality by one-third and her mortality between one and twelve months by three-quarters to bear comparison with the best countries. This would save 3,640 infant lives annually.
4. The West Central region of Scotland shows the highest infant mortality of any region in Great Britain. Taken as a whole, in both Scotland and England and Wales, the infant mortality is lower in rural areas than in urban areas. Even so, the predominantly rural areas of South-West and North-East Scotland are as bad as or worse than the mining villages and small industrial towns of the Lowlands of Scotland and the North-East of England.

   The excess mortality in urban areas in general suggests that certain town influences adversely affect infant mortality but recent experience in the U.S.A. and Holland shows that such influences can be overcome.

   It is apparent that there is a general surplus of adverse conditions in Scotland affecting both rural and urban areas and that there is as yet

little evidence of any tendency of special hospital and medical services in large towns and cities to offset their disadvantages.

5. Edinburgh is the only Scottish city which compares at all favourably with cities of similar size in England and Wales. Glasgow in 1934–38 had a higher infant mortality rate than any other of the twenty-four large burghs in Scotland or any of the eighty-four county boroughs of England and Wales.
6. The infant mortality rate for Scotland as a whole is no better than that found among the poorer working classes in England and Wales.
7. The failure in Scotland to reduce the infant mortality rate between one and twelve months is mainly due to the fact that the death rate from infections remains high.
8. Prematurity plays a dominant part in the causation of death in the first month. Reliable statistics are not available for the general incidence of prematurity in Scotland, but such evidence as exists indicates that the rate is high.

   Some improvement could be made in the neonatal deaths of premature infants by improved isolation and nursing but it would be even more important to discover and remove the causes of premature birth.
9. If climate has any effect on the broad geographical distribution of infant mortality, it is not detectable in the evidence examined. But the winter peak of infant mortality suggests that winter weather does affect the incidence of and mortality from infections and the effect of bad weather would be most felt where housing conditions are worst.
10. Adverse economic and social conditions have a direct effect on the infants' chances of survival. In Scotland, as compared with England and Wales, the percentage of unemployment is higher, the proportion of people living in poverty is twice as high and the percentage of overcrowding is six times as great. This explains the high rate of infections referred to in paragraph 7 above.
11. The experience of Holland has shown that the infant mortality rate can be reduced to a very low level, although the birth rate is high.
12. Although it contributes little to the total mortality, the high death rate of illegitimate infants is a serious problem in itself and could be improved by better standards of care for the unmarried mother and her child.

PART TWO

STILLBIRTHS

CHAPTER 5—THE INCIDENCE OF STILLBIRTHS

Countries compared : Accurate information on the incidence of stillbirths exists only for a few countries, and only for a few years. Registration of stillbirths has been compulsory in New Zealand since 1913, in Holland since 1925, in Canada since 1926, in England and Wales since 1927 and in Scotland only since 1939.* These countries are compared in Table 23.

Table 23.—Stillbirths in Different Countries. Rates per 1,000 Total Births

Period.	Holland.	Canada.	New Zealand.	England and Wales.	Scotland.
1916–20	..	..	26	..	..
1921–25	..	..	30	..	..
1926–30	25	31	31	40 [1]	..
1931–35	25	29	29	41	..
1936–40	25 [2]	27	29	38	42 [3]
1934	25	28	28	40	..
1935	25	28	30	41	..
1936	25	28	29	40	..
1937	25	28	28	39	..
1938	25	27	27	38	..
1939	..	27	30	38	42
1940	..	26	29	36	42
1941	..	26	27	34	39
1942	..	..	..	33	38

[1] 1928–30. [2] 1936–38. [3] 1939–40.

There has been some decline in the rate in Britain during the war. The excess in Scotland is of the same order as the excess of neonatal mortality. In each country, the stillbirth and neonatal mortality rates are of similar magnitude (Table 24) and, as total mortality decreases, form an increasing proportion of the whole.

Table 24.—Mortalities at Different Ages Compared, 1939. Rates per 1,000 Total Births

Country.	Stillbirths.	Neonatal deaths.	Stillbirths and Neonatal deaths.	Deaths 1–12 months.	Total mortality.
New Zealand	30	21	51	9	60
Holland (1938)	25	21	46	15	61
Canada	27	30	57	29	86
England and Wales	38	27	65	21	86
Scotland	42	35	77	31	108

* For this reason comparisons of stillbirths must be brought into the war period. Apart from this, the discussion is confined to the pre-war position.

This supports the earlier contention that there are important causes operating before and immediately after birth, different from those which are the chief determining causes of death after the first month. Causes of the second class are more easily brought under control than those of the first.

Districts and Cities of Great Britain : These different causes, although distinguishable in effect, tend to operate together. Where the total mortality is high the stillbirth rate is high also. This was shown in the last table and is further shown in a comparison of areas and towns in Great Britain in Table 25.

Table 25.—Stillbirth Rates (S.B.R.) and Infant Mortality Rate (I.M.R.) Compared. Areas and Towns of Great Britain

	S.B.R. 1929–33	S.B.R. 1934–38	S.B.R. 1939–41	I.M.R. 1939–41		S.B.R. 1939–41	I.M.R. 1939–41
ENGLAND & WALES	41	40	36	55	**SCOTLAND**	41	77
Greater London	33	32	30	44	Large burghs	42	85
Other county boroughs	43	41	38	64	Small burghs }	40	66
Other urban districts	43	43	38	54	Landward areas }		
Rural districts	41	40	36	51			
					West Central	43	87
Wales	55	53	46	66	East ,,	41	68
North	45	44	—	—	South	38	64
Midland	—	40	—	—	North	37	62
East	—	37	—	—			
South-West	—	39	—	—	Glasgow	44	95
South-East, excluding Greater London	—	34	—	—	Edinburgh	39	64
Greater London	—	32	30	44	Dundee	46	77
					Aberdeen	36	74
London [1]	33	32	30	45			
Liverpool, Bootle & Birkenhead	40	40	37	78			
Birmingham	39	36	33	66			
Manchester & Salford	48	45	43	73			
Sheffield	45	39	34	56			
Leeds	46	42	39	58			
Bristol	40	40	36	51			
Newcastle & Gateshead	41	39	37	83			
Hull	39	39	37	67			
Bradford	46	47	45	66			
Nottingham	42	39	34	68			
Stoke-on-Trent	52	52	43	62			
West Ham	33	31	30	41			
Leicester	39	35	34	52			
Portsmouth	39	35	32	49			
Croydon	32	32	27	37			
Cardiff	50	47	42	63			
Plymouth	41	38	34	57			
Coventry	37	38	38	55			
Sunderland	39	39	37	84			
Southampton	35	37	32	48			
Bolton	56	54	47	69			
Swansea	54	51	41	64			

[1] Administrative County of London.

Mortality by Occupation or Social Class : The Registrars-General have not yet made an analysis of stillbirths by occupation, but the incidence, as shown in Tables 24 and 25, and data to be presented below (Tables 26 and 27) suggest that a social distribution similar to that of neonatal mortality would be found. In a special study of 1,083 deaths in four districts, two urban and two rural, an attempt was made (Campbell and McKinlay, 1929) to distribute the deaths according to the classification adopted by the Registrar-General (England and Wales). The results were inconclusive, probably because only deaths were investigated, not the concurrent successful births, and the samples were small.

Evidence of the existence of a social gradient in incidence of stillbirths is provided by studies in Stockholm (Rietz, 1930) and Aberdeen (Baird, unpublished).

The data analysed by Rietz refer to legitimate infants born in Stockholm and suburbs between 1918 and 1922. The total number of births was 17,856 and of deaths 656.

Table 26.—Infant Mortality in Relation to Income Class in Stockholm, 1918–22

	Rate per 1,000 live births when father's income was :				
	Less than £240.	£240–£360	£360–£600	£600 or more.	All income groups.
Deaths during 1st year .	48·9	38·3	31·9	14·3	36·7
Deaths during 1st month	24·0	15·1	19·7	11·4	18·0
Deaths 1–12 months .	24·8	23·2	12·2	2·9	18·8
Stillbirths per 1000 live births . . .	17·5	15·8	13·0	8·8	15·1

In the Aberdeen analysis three groups are distinguished (Table 27). The first two are of upper middle-class women with all the advantages of good diet, adequate rest and good postpartum nursing care. They differed in the obstetrical care they received, the first group being attended by a specialist and the second by a family doctor. The stillbirth rate in the second group was three times and the neonatal rate twice that in the first, the difference being chiefly due to birth trauma.

The first and third groups were both supervised by specialists so that there was much less difference in obstetrical care between them than between groups 1 and 2. The chief difference was in type of patient. In groups 1 and 2 the incidence of contracted pelvis, toxæmia and premature labour was much less,

Table 27.—Comparison of Three Groups of Births in Aberdeen, 1938–42

	Number of births.	Per 1,000 total births.			
		Stillbirths.	Neonatal deaths.	Premature labour.	Pre-eclampsia.
1. Upper middle class attended by specialist .	365	11·0	5·5	20	36
2. Upper middle class attended by family doctor	814	33·2	13·5	60	not known
3. Working class Hospital " booked " cases	6,266	30·3	34·0	90	82

and the general nutritional condition of the women was much better, than in group 3.

Comparing Tables 26 and 27, the stillbirth and neonatal rates in the highest income group in Stockholm correspond closely to those of group I in the Aberdeen study. These, therefore, represent the results that may be obtained where the health of the mother, obstetric skill and nursing care are all good.

The Possible Saving of Life : By reducing her 1939 rate of 42 to Holland's level of 25, Scotland would save 1,570 lives annually. Taken with the possible saving of live-born infants (Part I, p. 11), this means a total of 5,210 lives unnecessarily lost each year.

CHAPTER 6—THE CAUSES OF STILLBIRTH

Scotland as a Whole : The Registrar-General for England and Wales does not publish analyses of the causes of stillbirths. An analysis of the registered causes in Scotland in 1939 (Preliminary Returns) is as shown in Table 28.

Table 28.—Causes of Stillbirth : Scotland, 1939

Cause of stillbirth.	Number.		Rate per 1,000 total births.	Per cent. of total stillbirths.
Difficult labour :				
Torsion of umbilical cord	95			
Prolapse of cord	185			
Malpresentations	285			
Pelvic deformity	64	889	9·8	23·2
Prolonged labour and uterine inertia	188			
Injury at birth, cerebral hæmorrhage	72			
Fœtal deformity	529	529	5·8	13·8
Antepartum hæmorrhage :				
Accidental hæmorrhage	258			
Antepartum hæmorrhage (not defined)	87	495	5·5	12·9
Placenta prævia	150			
Acute toxaemia	342	342	3·8	8·9
Chronic disease of mother	83	83	0·9	2·2
Other specified causes	236	236	2·6	6·2
Ill defined :				
Asphyxia	341			
Debility	69			
Atelectasis	24	895	9·9	23·4
Macerated fœtus	175			
Prematurity	286			
Unknown	363	363	4·0	9·5
Total		3,832	42·3	100·0

The Registrar-General makes the following comment in his Annual Report for 1939 : " Of the broad groups, the largest number is contained in the ill-defined and unknown. Of the total 3,832 stillbirths, the cause is ill-defined in 901 and is stated to be unknown in 362 cases. Part of this high proportion of ill-defined and unknown causes is, no doubt, due to the novelty of the scheme and will doubtless be reduced as the value of specification of stillbirths by cause becomes apparent. For instance, in the group of ill-defined causes, 341 are ascribed to asphyxia, some of which are probably due to difficulties of delivery of various kinds ; macerated fœtus (175), of which in some cases the cause (toxæmia, syphilis, etc.) may have been known to the certifier. It will be noted that the 362 cases where it was definitely stated that no obvious cause was apparent represent nearly one-tenth of all stillbirths. If no large part of this group is attributable to detectable causes, and therefore not likely to be reduced by more accurate recording on the certificate of the cause of death, the size of the group is of itself evidence sufficient to show the need for investigation of the factors leading to stillbirth before any hope of improvement can be entertained."

Since, then, the value of registration of cause lies in the possible indication of methods of prevention, and since causes of stillbirth will certainly be divisible into two parts, those arising primarily from the hazards of birth and those pre-

existing in the child or mother, an attempt has been made to subdivide this classification according to these two types (Table 29).

Table 29.—Causes of Stillbirth in Scotland Subdivided (1939)

Hazards of birth.			Pre-existing at birth.		
	Number.	Per cent.		Number.	Per cent.
Difficult labour :			*Fœtal deformity* . .	529	13·8
Torsion of cord . .	95	2·5	*Antepartum hæmorrhage :*		
Prolapse of cord .	185	4·8	Placenta prævia . .	150	3·9
Malpresentation . .	285	7·4	Accidental hæmorrhage	258	6·7
Pelvic deformity .	64	1·7	Antepartum ,, (not defined) . .	87	2·3
Prolonged labour and uterine inertia .	188	4·9	*Toxæmia* . . .	342	8·9
Injury at birth . .	72	1·9	*Chronic disease of mother* .	83	2·2
Other specified causes .	236	6·2	*Ill defined :*		
Ill defined :			Debility . . .	69	1·8
Asphyxia . . .	341	8·9	Atelectasis . . .	24	0·6
			Macerated fœtus . .	175	4·6
Total .	1,466	38·3	Prematurity . .	286	7·5
			Unknown . . .	363	9·5
			Total .	2,366	61·7

It is probably wrong to classify all the deaths attributed to asphyxia under hazards of birth because, although some of them, like neonatal deaths, will be due to cerebral injury, others are almost certainly due to defective development and should be in the second group. It is also true that many of the deaths in difficult labour will be due to poor physique of the mother, e.g. contracted pelvis, or to poor health leading to prolonged labour and uterine inertia. But, since much can be done by good obstetrics to prevent stillbirth even in cases of contracted pelvis, all have been included under hazards of birth. It has been assumed, although this is unlikely, that all the minor specified causes belong also to this class.*

Antepartum hæmorrhage has been allocated to the other side. Something can be done by Cæsarean section to reduce stillbirths in cases of placenta prævia but the condition obviously belongs to those pre-existing at birth. In accidental hæmorrhage separation of the placenta is usually due to some pre-existing abnormality and not to the stress of a normal labour. Since there was no obvious cause of death in the " unknown " cases, it seems more likely that they should belong to the second than to the first class.

On a conservative estimate, therefore, in at least 60 per cent. of the cases, there is little or no hope of reducing the stillbirth rate by better obstetrics in the narrow sense of care of the woman during labour. This view is strengthened by studies which have included observations on the time of death. In Campbell and McKinlay's (1929) study, from 22 to 45 per cent. of deaths were stated to have occurred before the onset of labour. Eden (1931) considers that the evidence from hospitals indicates that about 50 per cent. of stillborn infants die before labour begins and Dunham *et al.* (1938) record a still higher proportion, namely 58 per cent.

Hospital Data : The above analysis may be compared with a similar analysis of stillbirths at the Aberdeen Maternity Hospital during the years 1938–42. These have been divided into full-time and premature births, and " booked " are distinguished from " emergency " cases.† (Table 30.)

* These tables were prepared from the Quarterly Returns of the Registrar-General for 1939. Since this was written, it has been possible to consult the Annual Reports for 1939 and 1940. From these it appears that more than half of the " other specified causes " should be classed with causes pre-existing at birth. This would increase slightly the percentage of cases in this class.

† It has been stated on page 22 that hospital data do not represent a cross section of a community. This difficulty would be partly got over if hospitals conducting antenatal

Table 30.—Causes of Stillbirth, Aberdeen Maternity Hospital, 1938 to 1942

Hazards of birth.	Number.	Per cent.	Pre-existing at birth.	Number.	Per cent.
Booked cases : full-time.					
Asphyxia	—	—	Fœtal deformity	7	3·7
Difficult labour	29	15·3	Placenta prævia	1	0·5
Others	7	3·7	Accidental hæmorrhage	12	6·3
	—		Toxæmia	10	5·3
Total	36	18·9	Intercurrent disease	—	—
			Unknown	34	17·9
			Total	64	33·7
Booked cases : premature.					
Others	2	1·1	Fœtal deformity	15	7·9
			Placenta prævia	6	3·2
			Accidental hæmorrhage	8	4·2
			Toxæmia	18	9·5
			Intercurrent disease	14	7·4
			Unknown	27	14·2
			Total	88	46·3
Total, all booked cases	38	20·0	Total, all booked cases	152	80·0
Emergency cases : full-time.					
Asphyxia	—	—	Fœtal deformity	—	—
Difficult labour	47	16·3	Placenta prævia	14	4·8
Others	11	3·8	Accidental hæmorrhage	9	3·1
	—		Toxæmia	37	12·8
Total	58	20·1	Intercurrent disease	—	—
			Unknown	8	2·8
			Total	68	23·5
Emergency cases : premature.					
Others	18	6·2	Fœtal deformity	13	4·5
			Placenta prævia	21	7·3
			Accidental hæmorrhage	23	8·0
			Toxæmia	70	24·2
			Intercurrent disease	—	—
			Unknown	18	6·2
			Total	145	50·2
Total, all emergency cases	76	26·3	Total, all emergency cases	213	73·7

clinics separated in their records " booked " cases from " emergencies." For instance, at Aberdeen Maternity Hospital, " booked " cases represent the working-class population attending antenatal clinics, including an excess of primiparæ, those with known complications and those from the poorest and most crowded homes, leaving an excess of later births and of uncomplicated deliveries to domiciliary midwifery in the better homes. " Emergency " cases represent selected sick or otherwise abnormal women from those not attending antenatal clinics. The cases not included in these categories or cared for at nursing homes, where the experience will be similar to that of the hospital, would therefore be expected to show a mortality lower than that of the city as a whole and still lower than that of the hospital. Rough calculations show this to be true, although accurate comparisons could not be made without an *ad hoc* survey.

The booked cases with a stillbirth rate of 30·3, that is less than three-fourths of the Scottish rate of 42 in 1939, show a shift from hazards to pre-existing causes in the distribution of deaths. The difference is almost entirely due to reduction of deaths from the hazards of birth, but, when it is recalled that the hospital population is to some extent selected, the reduction in deaths due to maternal abnormality is probably greater than appears. The case records suggest that little further improvement can be obtained by obstetrical skill since most of the deaths were associated with very prolonged labour due to uterine dysfunction. The proportion of deaths from hazards of birth is higher in the emergency cases, although still substantially less than that in the general Scottish distribution. Many of these deaths could have been avoided if the patients had been admitted to hospital sooner. On the basis of the booked hospital cases, it might be inferred that the Scottish rate could be reduced from 42 (in 1939) to 33 by better obstetrics and by better supervision so that admission of complicated cases to hospital is not too late.

Turning to the conditions pre-existing at birth, in order to compare the relative incidence of causes of death, these have been expressed as percentages of the total number of cases in this group. The result is shown in Table 31.

Table 31.—Percentage Distribution of Causes of Stillbirth

	All Scotland, 1939.	Aberdeen Maternity Hospital, 1938–42.	
		Booked cases.	Emergency cases.
Fœtal deformity . .	22·4	14·5	6·1
Placenta prævia . .	6·3	4·6	16·4
Antepartum hæmorrhage	14·6	13·2	15·0
Toxæmia . . .	14·5	18·4	50·2
Chronic disease . .	3·5	9·2	—
Ill defined and unknown	38·8	40·1	12·2

In the original analysis of Scottish stillbirths (Table 28), 9·5 per cent. were classified under "cause unknown." In the Aberdeen booked hospital cases, 32 per cent. of the total were so classified. Hence the more accurate certification possible in hospital has not reduced but increased the proportion of unexplained stillbirths. It is probable that most of the deaths in the "ill defined" group in the Scottish analysis should be added to the "cause unknown" total, and Table 31 shows that this would bring the two distributions into close agreement on this point. It appears, therefore, that, while the immediate cause of death should be ascertained by post-mortem examination in every case where that is possible, this in itself will neither help to define a larger number of causes nor directly to lower the stillbirth rate.

Antepartum hæmorrhage and toxæmia are in many cases the immediate causes of death but they are not, strictly speaking, primary causes. They are themselves due to causes which are unknown. Hence the total of stillbirths due to unknown causes is much higher than appears from the classification and more progress in reducing stillbirths is likely to result from studying the antenatal condition of mothers in areas where the stillbirth rate is low than from intensification of pathological and bacteriological studies after the child is dead.

On the other hand, the data for the selected sick show a striking divergence from the other distributions with large excesses of stillbirths due to placenta prævia and toxæmia. It is obvious that a proportion of these stillbirths could be prevented by earlier diagnosis and treatment.

Incidence and Effect of Prematurity : A comparison of Scottish with other data (Table 32) shows the incidence of prematurity and its effect on the rates.

It is impossible to make reliable deductions from the hospital figures without information on the nature of the hospital experience. The relative proportions of booked and emergency cases will greatly influence the general rate. This is shown by the Aberdeen figures where the incidence and the effect of prematurity in booked cases approach most nearly to the American. The other extreme is shown by Glasgow Maternity Hospital where a high proportion of the births are in selected abnormal and emergency cases. In contrast with the stillbirth rate of 108 for those delivered in hospital, the Outdoor Service of the Hospital, dealing with the normal residuum of the cases under supervision, recorded in the same year 3,202 births with only 77 stillbirths, i.e. 26 per 1,000. With these reservations, the incidence of prematurity in Scottish hospital experience

Table 32.—Comparison of Stillbirth Rates and Incidence of Prematurity

	Total births : number.	Per cent. premature.	Stillbirth rates.		
			Premature per 1,000 premature births.	Full-time per 1,000 full-time births.	General rate.
New York State (excluding New York City), 1936 . . . [Yerushalmy, 1938.]	84,515	—	249	15·1	28·1
New York State (excluding New York City), 1936–38 . . [Yerushalmy, 1940.]	258,525	5·6	—	—	27·8
Johns Hopkins Hospital, Baltimore, 1896–1936 . . . [Peckham, 1938] White only.	18,801	7·0	185	33·7	44·3
Chicago Lying-in Hospital, 1931–38 . . . . [Potter and Adair, 1938]	17,728	6·3	—	—	22·7
Cincinnati General Hospital (one year) . . . . [Anderson *et al.*, 1941.]	2,481	11·0	143	10·4	25·0
Edinburgh Maternity Hospital, 1939–40 . . . . [McNeil, 1942.]	5,300	12·3	322	43·9	78·1
Aberdeen Maternity Hospital, 1941–42:					
Booked . . .	2,841	8·8	173	19·3	32·7
Emergency . . .	507	39·4	280	140·1	195·3
Total . . . [Baird, unpublished.]	3,348	13·4	220	32·1	57·3
Glasgow Royal Maternity Hospital, 1941 . . . . [Report for 1941.]	3,094	—	—	—	107·6

appears to be higher than in America. The increases in stillbirth rate due to prematurity are in all instances substantial, though less than for neonatal deaths.

Further valuable evidence of the importance, for survival to birth and after, of antenatal development is given in Peckham's study. Fig. 5, relating to white single births, is reproduced from his paper.

It shows that, for weights up to 1,200 g. (2·6 lb.), a falling stillbirth rate was compensated by a rising neonatal mortality, so that the two together remained stationary at about 90 per cent. of births. From 1,200 g. to 2,500 g. (5·5 lb.) both rates decreased, neonatal more rapidly than stillbirth, but the rates were not stabilised until the weight reached between 2,700 and 2,800 g. (about 6 lb.). At this stage of development, the stillbirth rate was about 25 per 1,000 total births and the neonatal death rate 9 per 1,000 live births.

Holland is the only country in which the stillbirth rate has reached Peck-

ham's stabilised weight level. New Zealand and Canada are approaching it. The best population groups in these countries have possibly reached a level

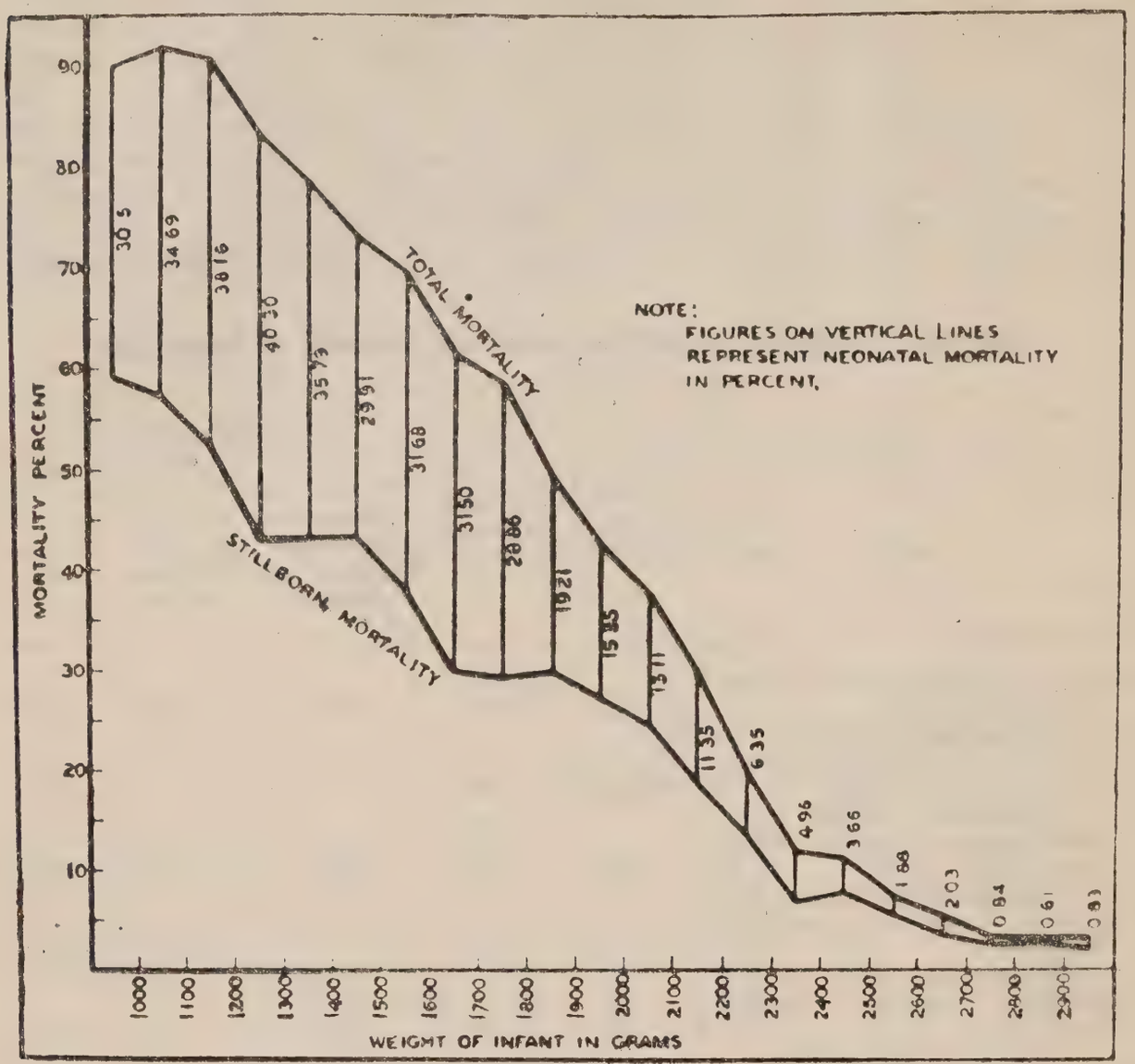


FIG. 5.

Stillborn and neonatal mortality, according to weight of infant (single births only).

After Peckham, 1938.

far below 20, comparable with those recorded for Stockholm in Table 26 and group 1 in Aberdeen in Table 27.

CHAPTER 7—ASSOCIATIONS WITH HIGH STILLBIRTH RATE

General : The conditions associated with high stillbirth rate are, in general, the same as those associated with high neonatal rate and high total infant mortality, namely poverty, poor housing and sanitation, overcrowding, relatively high birth rate and poor diet. All of these must clearly affect the health of the mother.

Age and Parity : In addition, information is available on the distribution of stillbirths according to the age of the mother and the order of birth. The rates shown in Table 33 have been calculated from the data in the Registrar-General's Statistical Review of England and Wales for 1938.

The stillbirth rate is relatively high in the first pregnancy, least in the second and thereafter rises with each pregnancy. The rate is least in women under twenty-five years of age and, in each parity, it rises with age. Similar tables

prepared by the Registrar-General for Scotland for 1939 and 1940 deal with a much smaller total of stillbirths but suggest the same general trend.

Table 33.—Stillbirth Rates (Single Births only) by Age and Parity of Mother. England and Wales, 1938

Parity.	Age of mother.						
	Under 20	20–24	25–29	30–34	35–39	40+	All ages.
1	27·2	31·0	39·6	55·5	82·1	117·0	40·8
2	19·6	18·0	21·6	25·5	39·5	53·0	24·1
3		20·0	23·4	29·6	44·9	62·5	30·0
4		20·7	25·6	28·2	45·0	68·0	33·8
5			39·5	29·2	47·6	74·5	41·6
6			39·0	41·6	47·5	67·0	47·3
7				43·2	43·0	70·6	49·4
8				36·2	52·2	68·8	53·3
9				}	54·0	67·0	57·3
10				} 48·5	45·0	60·0	51·2
11+				}	67·4	78·8	74·4
All parities .	26·5	26·6	31·3	37·1	51·2	71·4	36·6

1st Pregnancy . . . 42 per cent. of total births.
2nd ,, . . . 26 ,, ,, ,, ,, ,,
3rd, 4th and 5th Pregnancy . 24 ,, ,, ,, ,, ,,
6th Pregnancy + . . 8 ,, ,, ,, ,, ,,
42 per cent. of the primiparæ were under 25 years of age.

It would be in accordance, Peckham says, with general belief to assume that the increase in stillbirths with age and parity, after the second birth, is due partly at least to increase in premature births. But Peckham's analysis lends little support to this view. In his records there was no evidence of an increase in incidence of prematurity before the age of thirty-five, or before the tenth pregnancy. The viability of the fœtus must therefore be reduced with increasing age of the mother and repeated pregnancies, even if it is not born before it reaches $5\frac{1}{2}$ lb. weight.

The age and parity distribution in the Aberdeen study, for which the mortality rates were shown in Table 27, are shown in Table 34.

Table 34.—Percentage Age and Parity Distribution of Aberdeen Cases

	Parity				Primigravidæ under 25 years.
	1	2	3–5	6+	
1 and 2. Upper middle class .	66	24	9	—	18
3. Hospital booked cases .	41	23	25	11	62

In the combined upper middle class groups, there was a much higher percentage of first, and fewer later pregnancies than among the hospital cases. The average age of the primigravidæ was also much higher. From the Registrar-General's distribution (Table 33), stillbirth rates of about 39 for the upper middle class group and 35 for the hospital group would be expected, compared with actual rates of 26 and 30. Hence both are below expectation from the distribution for England and Wales as a whole; the middle-class group very much below, in spite of a relatively unfavourable age and parity composition.

The advantages of superior physique and health more than compensate for the other disadvantages.

How far, then, can unfavourable age and parity be held responsible for the excess stillbirths in Scotland? To answer this question, the data shown in Table 35 have been assembled. The Registrar-General gives the age and parity distribution of all births in the areas shown, but not the stillbirth rates by age and parity for the separate areas. A comparison has therefore been made on the assumption that the rates would be the same as for England and Wales as a whole.

The calculated English and Welsh rates differ only slightly from area to

Table 35.—Stillbirth Rates for 1938

Area.	Actual legitimate stillbirth rate.	Calculated legitimate stillbirth-rate.	Gross reproduction rate.	Birth-rate.
Scotland	41·9 [1]	35·4	1·08	17·7
England and Wales	37·5	37·5	0·90	15·1
Greater London	29·9	38·2	0·79	14·3
South-East, excluding Greater London	33·5	37·5	0·89	14·5
South-West	39·3	38·2	0·88	13·6
East	36·6	37·1	0·95	14·7
Midland I	35·9	37·7	0·99	16·4
Midland II	39·6	38·0	0·91	15·4
North I	38·5	36·6	1·00	16·8
North II	35·9	36·4	1·03	16·6
North III	40·2	36·9	0·91	15·3
North IV	45·9	37·3	0·89	15·1
Wales I	47·7	37·4	0·97	15·4
Wales II	46·0	38·7	0·96	14·8

[1] Legitimate stillbirth rate for 1939.

area with a range from 36·4 to 38·7. Greater London, with a worse than average age and parity distribution, has the lowest rate of all. Of the four other areas with actual stillbirth rates below the average, three have better than average distributions. Of the seven areas with rates above the average, four have better and three worse than average distributions. Hence in England and Wales, there is no obvious correlation between age and parity distribution and stillbirth rate. In Scotland the age and parity distribution is more favourable to a low stillbirth rate than in any of the English areas, but its actual rate is higher than any except North IV and the two Welsh areas. This point is further illustrated by the following table.

Table 36.—Distribution of Stillbirths by Age of Mother in Selected Areas. 1938

Place.	Age of mother.							
	All ages.	Under 20	20–24	25–29	30–34	35–39	40–44	44+
New York State, excluding New York City [Yerushalmy, 1940.]	28	25	21	24	31	42	62	
Greater London	31	24	22	27	29	42	60	122
England, North IV	46	35	35	40	47	67	80	86
Wales I	48	34	33	40	48	67	79	157
England and Wales	38	29	28	32	38	53	69	102

The two bad areas, North IV and Wales I, show an excess at all ages. In the age group 20 to 24 the excess over London or New York is 50 per cent. This cannot be attributed to closeness of spacing of births and consequent higher average parity because the general distribution shows no definite increase even with the fourth birth in this age group. Hence there are influences operating in Wales and the North of England which increase the stillbirth rate even between the ages of twenty and twenty-four when the prospects are best. Since these are depressed areas, the influences most likely to be responsible for the excess mortality are poor physique of the mother, poor diet during pregnancy and probably a poor standard of obstetric care.

Illegitimacy : The next table shows the effect of illegitimacy on the stillbirth rate in England and Wales.

Table 37.—Incidence of Illegitimacy and Comparison of Legitimate and Illegitimate Stillbirth Rates

	Illegitimate births per cent. of total births.	Illegitimate stillbirth rate.	Legitimate stillbirth rate.	Total stillbirth rate.
England and Wales—				
1934	4·4	53·9	39·9	40·5
1935	4·2	49·2	40·4	40·7
1936	4·2	50·9	40·9	39·7
1937	4·2	50·5	38·5	39·0
1938	4·3	49·6	37·8	38·3
1934–1938	4·3	50·8	39·1	39·6
Greater London, 1934–1938	4·6	44·4	31·2	31·8
Other County Boroughs, 1934–1938	4·4	50·6	40·8	41·3
Urban Districts, 1934–1938	3·9	54·4	42·1	42·6
Rural Districts, 1934–1938	4·3	51·4	39·9	40·4
Scotland—				
1939	6·0	48·0	41·9	42·2
1940	5·9	51·2	41·5	42·1

The difference between legitimate and illegitimate stillbirth rates is less than that between the corresponding mortalities of live-born infants (Table 22, p. 31). Although the rates for illegitimate births are, on the average, about 20 to 25 per cent. above those for legitimate, the total effect is to increase the stillbirth rate by only 0·5 per 1,000 births.

SUMMARY OF PART TWO

1. Scotland shows an excess of stillbirths, in comparison with such countries as New Zealand and Holland, of the same order as the excess of neonatal deaths.
2. The excess has the same regional distribution as that of later infant deaths. It is highly probable that the occupational, or social, distribution is also the same.
3. Looking at the causes of stillbirth in Scotland generally, it is noted that in 1939, when the stillbirth rate was 42 per 1,000 total births, 38 per cent. were attributed to hazards of birth and 62 per cent. to abnormalities pre-existing in the mothers. During the five years 1938–1942 the stillbirth rate in booked cases at Aberdeen Maternity Hospital (with some adverse selection) was only 30 per 1,000. Of these, 20 per cent. were classed under hazards of birth and 80 per cent. under pre-existing conditions. The difference between the general rate and the Aberdeen Hospital rate is due chiefly to reduction at the Hospital of deaths due to the hazards of birth.

4. A study of stillbirths in " emergency " cases admitted to Maternity Hospitals shows that more of the deaths are associated with pre-existing abnormal conditions in the mother than with the hazards of birth. In the Aberdeen Maternity Hospital the proportions are 74 and 26 per cent. In the group of stillbirths attributed to pre-existing abnormalities, half were associated with severe toxæmia and in many of these cases the antenatal care was poor. In the group attributed to the hazards of birth, many of the deaths could have been avoided if the women had been sent to hospital earlier. Many stillbirths could therefore be avoided by better antenatal supervision and obstetric care.
5. It is calculated that greater obstetrical skill throughout the country should reduce the Scottish stillbirth rate to 33 and the extension of antenatal care should further reduce the general rate below that of the Aberdeen Hospital booked cases (because they are a selected group) ; i.e. to less than 30. In the same area, the stillbirth rate in specialist practice was only 11 per 1,000 and this seems to represent the basic rate attainable under really good conditions.
6. The difference between the hospital booked population and specialist practice is explained by prolonged labour due to uterine dysfunction on the one hand and by unknown causes, toxæmia, accidental hæmorrhage and prematurity on the other. The data for stillbirths support the contention in Part I that the incidence of premature birth in Scotland is high.
7. Since the incidence of all these known and unexplained conditions is so much less among the well-to-do, it seems probable that the primary difference lies in the health of the mothers. And health, in this sense, implies better feeding and more rest during the pregnancy, in addition to the better physique which results from good feeding and environment from birth.
8. No other significant adverse influence was found. The age and parity distribution, in spite of the relatively high birth rate in Scotland, is favourable to a low mortality rate and the effect of illegitimacy is negligible.

PART THREE

THE FEEDING OF MOTHERS AND INFANTS

CHAPTER 8—THE DIETS OF MOTHERS

The General Position : It was shown by Orr in 1936 that the adequacy of diets in the United Kingdom closely parallels the economic status of groups of the population. This was confirmed by the later Carnegie U.K. dietary survey (unpublished) and by numerous other surveys of particular groups. In general, the quality of the diet is reflected in the stature and health of the consumers.

These observations have shown that, in the United Kingdom, few diets reach the standards recently prescribed as optimal for health, and as many as 30 per cent. may be seriously deficient in several respects. The most common deficiencies are of calcium and vitamins A and C. It is a common observation in poor families that, where food is short, the mothers deprive themselves for the other members of the family. Hence, whenever it has been found that a diet is inadequate for the family as a whole, it will usually be true that the mother will suffer most.

Ad hoc Surveys : Few surveys of the diet of pregnant or nursing women individually have been made. The results of one such, on 120 pregnant women in England in 1938 (McCance *et al.*), are shown below in Table 38 in terms of

Table 38.—Amounts of Foods Eaten by Pregnant Women in Different Income Groups (McCance et al., 1938)

Foods per head per week.		1	2	3	4	5	6
Milk	pints	5·74	4·55	4·76	2·52	3·22	2·87
Cheese	oz.	2·1	0·7	1·4	1·4	0·7	2·1
Butter	,,	8·4	9·8	7·0	8·4	8·4	9·8
Margarine	,,	—	—	—	1·4	1·4	4·2
Eggs	number	4·2	4·2	2·8	3·5	3·5	2·8
Meat, fish (cooked wt.)	oz.	32·2	39·9	30·1	28·0	25·2	15·4
Fruit, fresh and tinned	,,	54·6	48·3	38·5	26·6	14·7	5·6
Potatoes (cooked wt.)	,,	26·6	36·4	46·2	32·9	25·2	20·3
Legumes, dried (cooked wt.)	,,	1·4	0·7	2·8	2·8	2·8	2·8
Green leafy vegetables (cooked wt.)	,,	18·2	16·8	18·9	9·1	6·3	4·2
Roots (cooked wt.)	,,	3·5	6·3	4·2	3·5	1·4	0·7
Raw vegetables and salads	,,	9·8	1·4	4·2	4·9	4·2	3·5
Total cereals as flour	,,	32·9	40·6	36·4	43·4	44·1	52·5
Sugars	,,	10·5	14·7	16·8	11·9	10·5	9·8
Jam and marmalade	,,	6·3	4·9	2·8	1·4	1·4	1·4

foods eaten. For comparison, Table 39 gives the allowances of foods recommended in 1936 by the League of Nations Technical Commission, in 1939 by Stiebeling (moderate cost diet) and in 1941 by Tisdall *et al.* Table 40 shows the analyses of the diets in terms of a number of constituents, and Table 41 the allowances proposed in 1941 by the U.S. National Research Council. It is plain that in all classes (Table 38) the consumption of milk, cheese, fruit and vegetables falls short of the amounts considered by authorities to be desirable. The usual social gradient in quality of diet is shown and the diets of the lowest income group fall below the standard for foods in all items except cereals and fats.

These differences in food consumption are reflected in the composition of the diets. The recommended allowance of 2,500 Calories is for the second half of pregnancy. Since McCance's survey included pregnancies between three and

nine months, without details of the distribution, it is impossible to say whether deficit of energy was common. It seems possible that the three lower groups were insufficiently nourished. Only the two highest groups approached the standard for protein and iron, and only the highest for calcium. The supply of vitamins A, B and C was inadequate except perhaps in the highest group, the position becoming progressively worse towards the lowest income group. The diets of the lower income groups would also provide less than the optimal amount of riboflavin and other components of the vitamin B_2 complex.

Similar observations on the diet of 200 pregnant women have been made by Williams and Fralin (1942) in the United States, and the analyses of these diets also show a social gradient, with undernourishment and deficiency of calcium, iron and vitamins, more marked in the lower cost diets. According to their

Table 39.—Diets Recommended for Pregnant and Nursing Women

	League of Nations, 1936.	Stiebeling (1939) (moderate cost).		Tisdall *et al.* (1941), to meet recommendations of U.S. National Research Council.	
Foods per head per week.	Pregnancy and lactation.	Pregnancy.	Lactation.	Pregnancy.	Lactation.
Milk . . . pints	12	12	12	14	14
Cheese . . . oz.	7·4	— [1]	— [1]	4	4·25
Butter . . . ,,	As needed	8·0	8·0	12	12
Other fats . . ,,	,,	4·8	12·8	4	8
Eggs . . number	7	7	7	3	3
Meat, fish . . oz.	29·5	41·6	41·6	20	20
Liver . . . ,,	— [2]	— [2]	— [2]	4	4
Tomatoes and citrus fruit . . . ,,	As needed	28·8	32·0	34	64
Potatoes . . ,,	61·5	41·6	51·2	56	56
Dried legumes and nuts . . . ,,	2·5	2·2	2·2	— [2]	4
Leafy green and yellow vegetables ,,	24·6	80·0	80·0	28	32
Other vegetables and fresh fruits . . ,,	— [2]	104·0	121·6	42	36
Bread and/or flour, cereals . . ,,	61·5	41·6	51·2	32	88
Sugars . . . ,,	As needed	12·8	16·0	16	16

[1] Cheese may be substituted for part of the milk.
[2] Not stated.

assessment the deficiency of riboflavin was of the same order as the deficiencies of vitamins A and C.

We have not been able to find individual dietary surveys of nursing mothers, except for professional wet nurses in America, where diets were supervised and of high quality. But, since the requirements for lactation are greater in all respects than those for pregnancy, it is most probable that the deficiencies are the same. Even if total food intake is increased, as it must be to maintain milk production, it is unlikely that the quality of the diet habitually eaten would be substantially changed. It would be most likely to deteriorate from increase in consumption of bread, sugar and fat, without increase in protective foods.

Correlation with Infant Mortality : Confirmation that these findings apply also in Scotland and, in addition, that deficiencies are correlated with stillbirth and prematurity is afforded by a survey in Glasgow by Graham and Cameron (unpublished) in 1942 of the diets of 300 mothers, of whom 100 had stillborn infants, 100 premature live-born infants and 100 full-term live infants. The results are shown in Table 42. The first half of the table shows the requirements and the values of the diets as recorded. The second half compares the quality of the diets if all the women had eaten amounts of the same foods to give the energy requirement of 2,500 Calories.

Table 40—Analysis of Diets of Pregnant Women by Income Groups (McCance et al., 1938) [1]

Income (less rent per head per week).	Number of Women.	Hb % Haldane.	Values per head, daily.										
			Cals.	Protein.		Ca g.	P g.	Fe mg.	Vitamin A. I.U.	Vitamin B_1.		Vitamin C.	
				Total g.	Animal g.					I.U.	mg.	I.U.	mg.
1. Over 40s. .	26	—	2498	80	55	0·94	1·45	14·4	5380	476	1·4	1974	99
2. 25s. to 40s. .	13	90	2781	86	55	0·75	1·32	14·8	4010	436	1·3	1646	82
3. 15s. to 25s. .	14	81	2471	75	46	0·75	1·22	13·3	4365	437	1·3	1771	89
4. 9s. to 15s. .	19	80	2194	66	37	0·52	0·99	12·0	3145	317	1·0	1143	57
5. 6s. to 9s. . .	23	79	2155	64	36	0·53	0·92	10·9	2620	273	0·8	795	40
6. Less than 6s. .	16	76	2211	60	28	0·51	0·80	8·6	2445	218	0·7	561	28

[1] The estimates of vitamin content have been added.

Table 41—Recommended Allowances for the Chief Known Dietary Essentials as Laid Down by the National Research Council, Washington. May, 1941

Per head per day.	Cals.	Prot. g.	Ca g.	Fe mg.	Vitamin A. I.U.	Vitamin B_1. mg.	Vitamin C. mg.	Riboflavin. mg.	Nicotinic Acid. mg.	Vitamin D. I.U.
Pregnancy (latter half)	2500	85	1·5	15	6000	1·8	100	2·5	18	400–800
Lactation . . .	3000	100	2·0	15	8000	2·3	150	3·0	23	400–800

Table 42—Average Values of the Diets of 300 Pregnant Women in Glasgow (Graham and Cameron, 1942 : unpublished)

	Requirements (Table 41).	Average Daily Value of Diets as Recorded.				Average Daily Value of Diets if the Energy Requirements of 2500 Calories had been met.			
		Mothers with Live-born Infants.		Mothers with Still-born Infants.		Mothers with Live-born Infants.		Mothers with Still-born Infants.	
		Full-term.	Premature.	Full-term.	Premature.	Full-term.	Premature.	Full-term.	Premature.
Calories : . . .	2500	1960	1700	1700	1670	2500	2500	2500	2500
Protein, total : g.	85	68	52	54	52	87	77	79	78
,, animal : g.	Not stated	42	27	28	25	54	40	41	38
Fat : g.		79	63	63	59	101	93	92	88
Carbohydrate : g.		231	217	218	220	294	320	320	330
Calcium : g.	1·5	1·26	0·85	0·83	0·83	1·61	1·25	1·22	1·24
Phosphorus : g.	Not stated	1·55	1·11	1·12	1·10	1·97	1·64	1·64	1·65
Iron : mg.	15	10	8	8	8	13	12	12	12
Vitamin A : I.U.	6000	2690	1830	1890	1680	3430	2690	2780	2520
Vitamin B_1 : I.U.	600	500	400	410	400	640	600	610	610
Vitamin C : I.U.	2000	840	620	620	600	1075	910	910	910

Statistical analysis of the data showed that the difference between the diets of mothers with full-term infants and mothers with premature infants was significant but not that between mothers with live premature and stillborn infants.

Due allowance must be made for the fact that these surveys were by questionnaire and not by weighing all food eaten. But the agreement with other accurate surveys, such as that of McCance *et al.* quoted above, and with the observations of Wills *et al.* (1942) on nurses, indicates that the figures are, without doubt, of the correct order.

These women had not increased their food intake during the last trimester of pregnancy, as they ought to have done. In relation to the accepted requirements for this period, they were all underfed and the mothers of premature and dead infants seriously so.

The second part of the table shows that if, without change of diet, they had all eaten enough food to provide their energy requirement of 2,500 Calories, the diets of the mothers of full-term babies would then have been adequate in protein, calcium and vitamin B_1,* only slightly deficient in iron, but still deficient in the other vitamins. The other diets all have less protein and fat and more carbohydrate ; less calcium and iron and an appreciably greater deficiency of vitamins A and C.

In comparison with accepted standards, therefore, the diets of poor mothers in general are characterised by low energy value, low protein content and deficiency of calcium, iron, vitamins A and C and riboflavin. This does not complete the list of deficiencies but enumerates only those definitely known.

Correlation with Poor Housing : It has been shown above that infant mortality rates vary with social class, that is to say, rise as poverty increases and diet deteriorates. High mortality rates are also associated with poor and insanitary housing and overcrowding. McGonigle and Kirby (1936) in Stockton-on-Tees found that the infant mortality rate during the five-year period following rehousing was insignificantly less than that in the control slum area. Both areas showed a notable reduction during that period. Child mortality at later ages was relatively higher in the rehoused area. McGonigle attributed the disappointing results to deterioration of diet due to the increased overhead costs of living in the new area. Experience has been similar in some but not all other areas. In some the influence of poor housing *per se* on mortality rates cannot be denied. In Glasgow experience has shown that by rehousing alone the death rate in young children from respiratory diseases can in some instances be reduced by more than half while the incidence of the commoner infectious diseases is materially reduced.

CHAPTER 9—THE CLINICAL IMPLICATIONS OF POOR MATERNAL DIET

A brief review of the effect of diet on pregnancy in animals and the survival of the young after birth is presented in Appendix 2. The implications for human pregnancy and infant mortality are considered here.

Underfeeding : In comparison with the accepted standard, the energy value of the poorer diets discussed above is low for the last part of pregnancy, and this remains so even if the standard requirement be reduced to correspond with the low average non-pregnant weight of poorer women. No sufficiently careful combined dietary and clinical study has been made from which the effect of such underfeeding could be assessed. It is unlikely that it would noticeably affect the birth weight, for, except in extreme deprivation, the fœtus will grow at the expense of the mother's body. An effect on birth weight is most likely to be seen in young primigravidæ where the mother's body may compete against

* The adequacy of these diets in vitamin B_1 is due to National Bread.

the fœtus for nourishment or in multiple pregnancy where the total fœtal demands are high.

The effect of underfeeding in pregnancy is most likely to be shown in failure to lay down reserves in preparation for lactation, without which lactation will be initiated but not maintained. The magnitude of the reserves that can be laid down in subjects with poor nutritional histories is shown in a recent study by Hummel *et al.* (1937). Underfeeding has been deliberately practised, and even recommended by doctors, in order to restrict birth weight. Apart from the fact that the attempt is unlikely to be successful, its probable effect on lactation makes it undesirable. Milk production can be maintained at the expense of the mother's body only for a short time and with serious effects on her health.

Deficiency of Protein : Restriction of protein intake in pregnancy was for long, and sometimes still is, considered desirable as a means of restricting the formation of " toxic " products in the blood and preventing " toxæmia." There is no scientific evidence to support this practice. Albuminuria is not evidence of excess protein intake and more success appears to have been achieved in the control of the toxæmias of pregnancy by a well-balanced diet of high protein content (see below, p. 53, Toxæmia).

Further, storage of protein during pregnancy is necessary for the successful establishment of lactation and a relatively high protein intake during lactation is necessary to maintain milk yield.

Lack of Calcium and Vitamin D : In the extreme case, lack of calcium or vitamin D during pregnancy results in osteomalacia in the mother and fœtal rickets in the child. With lesser degrees of deficiency the fœtal skeleton will be normally calcified at the expense of the maternal, but this process cannot be often repeated without injury to the mother or fœtus or both. It is probable that with repeated, closely spaced pregnancies on diets of low calcium content, the standard of calcification of the infant's skeleton at birth deteriorates. Such drafts on the maternal skeleton will, in each pregnancy, prejudice the coming lactation because it appears to be impossible to absorb and retain sufficient calcium, even when it is available in the diet, to provide, from current supplies, for a high milk yield. Skeletal reserves are necessary. Milk yield is strictly limited by the amount available from diet and reserves. The vitamin D content of breast milk, which is of importance for postnatal skeletal calcification, depends on the maternal supply from sunshine or a vitamin D concentrate such as cod liver oil.

Iron Deficiency : Anæmia due to iron deficiency is common in women of the working class and when women who have borne children are compared with women of the same age who have not, the anæmia is, at all ages, greater in the mothers. The average iron supply in working-class diets is, therefore, inadequate for the needs of women in general and the demands of reproduction are greater than the menstrual losses. Apart from the depletion of the iron reserves of the young adult, it is not certain that pregnancy has any effect on blood formation. During pregnancy the degree of anæmia appears to be intensified by dilution of the blood which is said to be maximal during the eighth month. In spite of this, the hæmoglobin level of pregnant women can be maintained at about 90 per cent. of that of the healthy non-pregnant adult by a balanced diet providing about 15 mg. of iron daily. This is shown, for instance, in Chapter 8, Table 40 above. If the diet is not altered, it is more difficult to prevent or cure the condition and opinion differs as to the medicinal doses of iron required. Indeed, some observers, failing to effect a cure with medicinal iron, have suggested that the anæmia is physiological. There is no real basis for this view. The secretory activity of the stomach is profoundly affected by poor diets and iron absorption may be so reduced as to make repair of the anæmia very slow.

It is impossible to state definitely whether iron deficiency anæmia in the mother affects blood formation in the fœtus or its viability at birth. But there is no doubt that it has a great effect on the strength and vigour of the mother, on her ability to care for the infant and hence on the infant's prospects of life and health.

Vitamin A Deficiency : There is no clinical information to show the effect

of deficiency of vitamin A on the development of the human fœtus and its healthy survival to birth but it is certain that, where the mother's diet is of low vitamin A content, the infant will start life without reserves. Indeed, there appears to be difficulty in getting vitamin A through the placenta to the fœtus and this renders the infant after birth all the more dependent on an adequate supply in the milk. Colostrum is much richer in vitamin A than later milk and is of special importance for that reason. The amount of vitamin A in colostrum and milk depends on both the mother's reserves and the current supply in her diet. Reserves accumulated during pregnancy would, therefore, be passed on to the infant after birth, even if they cannot be passed through the placenta.

Deficiency of Vitamins B_1 and B_2 Complex : There is no clinical evidence to distinguish the effect of minor degrees of deficiency of vitamin B_1 in human pregnancy. But there is an important clinical aspect of deficiency of the vitamin B_2 complex. The occurrence of macrocytic anæmia in pregnancy has been recognised for several years in tropical countries but, until more recently, the only type of anæmia of pregnancy in temperate regions was supposed to be microcytic and due solely to deficiency of iron. American workers within the past few years have, with increasing frequency, reported macrocytic anæmia as a not insignificant part of the anæmia of pregnant women. Within the last five years reports have been made on the same subject from Glasgow (Stevenson, 1938), Edinburgh (Davidson *et al.*, 1942), Aberdeen (Fullerton, 1943), Newcastle (Ungley, 1938 ; Miller and Studdert, 1942) and Burton-on-Trent (Lescher, 1942).

Barnum and Woodward (1938), from a review of the published data, estimated the incidence of macrocytic anæmia of pregnancy to be about 29 per 1,000 births in India and 1 in 10,000 births in the temperate zone. There can be no doubt that both are underestimates because the condition is not commonly recognised and the diagnosis requires laboratory confirmation. It has been so little studied that it is not properly differentiated from the so-called " toxæmias " and other conditions with which, Miller reports, it is confused.

The onset is usually about the seventh month, but the patients may not be seen until after delivery when they may be sent to hospital as cases of puerperal sepsis. Pyrexia is usual ; gastro-intestinal symptoms with severe prolonged vomiting are prominent ; there may be œdema. Other symptoms of deficiency of vitamin B_2 complex are sore tongue and paræsthesiæ. The confusion in diagnosis with toxæmia and puerperal sepsis, combined with the fact that spontaneous recovery may occur after delivery, suggests that the incidence may be much higher than is thought.

The condition as seen hitherto, that is in its more severe form, is grave. Barnum and Woodward report that death of the fœtus *in utero* is common, but if the child is born alive its prospects are good. In nineteen of the twenty-three cases studied in Newcastle, dietary histories were procured, and in seven of these there was gross deficiency of protein and vitamins. The condition is cured by administration of rich sources of the vitamin B_2 complex and there seems little doubt that general improvement of the diet of pregnant women or prophylactic supplements of such rich sources as liver and yeast would obviate the occurrence of the disease.

Deficiency of Vitamin C : Deficiency of vitamin C is not known to affect directly the course of human pregnancy but it may have indirect effects, for instance, on the absorption of iron. An abundant supply during lactation is, of course, required for the health of the infant.

Toxæmia. The etiology of the toxæmias of pregnancy is not understood. There may be more than one type, or other little-known conditions, such as macrocytic anæmia of pregnancy, may be classed under toxæmia. It is reasonably suggested that toxæmia may be due to endocrine imbalance and attempts, alleged to have had some success, have been made to control and cure it by treatment with different hormones. The obvious association with poor diet of the condition (or conditions) known as toxæmia has caused some writers to class " toxæmia " as a deficiency disease (McIlroy, 1934 ; Theobald, 1937). This is justifiable in as far as the manifestations can be controlled by diet. It has, until recently, been common practice to restrict the protein intake of toxæmic patients

to very low levels with the idea that this would control the hypertension and albuminuria. Recently American workers (Strauss, 1935, 1937, and others) have recommended a high protein intake. De Snoo (1937, 1938) in Holland advocates elimination of salt from the diet. There is an increasing weight of testimony from America that this treatment is helpful. Some American advocates have elaborated and extended the principle involved. Medicaments containing sodium are prohibited and the elimination of sodium from the body speeded by giving ammonium chloride. The diet is supplemented with vitamin concentrates, especially the B vitamins (Anderson, 1940 ; Strauss, 1937, 1939).

It is not claimed that this treatment prevents the occurrence of toxæmia but that it greatly improves the clinical condition and reduces the associated mortality. Two independent observations (Wadlow, 1940 ; Pomerance and Daichman, 1940) have also been made that unsalted diet improves uterine contractions and reduces both the duration and the distress of labour.

The several deficiencies of poor diets have been discussed separately but, in fact, they do not occur separately. The diets of poor mothers are such that they suffer from multiple deficiencies, of which now one, now another, may appear dominant because of individual idiosyncrasies of diet or differences in physiological constitution. The treatment of obvious symptoms with single drugs or vitamins may be abortive because of the other deficiencies, or may even unmask further deficiency. There is only one correct treatment and that is by adequate and well-balanced diet. The suggested prophylactic treatment of toxæmia by high protein, unsalted diet is probably in a different class and aims at counteracting a metabolic upset which the previous diet was unable to control.

Experiments with Supplemented Diets : There are three experiments to be discussed under this heading. The first (Williams, 1936–1938) began under the control of the National Birthday Trust in the Rhondda Valley in 1935. The initial experiments aimed at determining whether additional food, medicine or nursing care would favourably affect the high maternal mortality in that area. The experiment was extended, by a Committee of the Joint Council of Midwifery, to other areas in Wales, to County Durham and other depressed areas in the following two years and, in 1936, a revised scheme of investigation was prepared in co-operation with representatives from the Medical Research Council. For the first fifteen months under the revised plan, which covered areas in Northumberland, including Newcastle-on-Tyne, Durham and Glamorgan, 11,000 mothers were given supplementary foods and 25,000 were recorded as controls. In the fed group the combined stillbirth and infant mortality rate was 58 per 1,000 total births ; in the unfed group, 85. Within the latter group, the subgroup attending clinics had a combined rate of 71 and the others a rate of 92.

The second study was made in Toronto (Ebbs *et al.*, 1942). There were three groups of pregnant women : one of 120 on poor diets, not altered during the period of observation ; one of 90 on similar diets, supplemented by foods and

Table 43.—Principal Complications of Pregnancy : Toronto Feeding Experiment

	Poor diet. per cent.	Supplemented diet. per cent.	Good diet. per cent.
Prenatal period :			
Anæmia	28·6	16·1	21·6
Pre-eclampsia and eclampsia .	12·6	9·1	7·8
Threatened miscarriage . .	11·2	8·3	4·7
Labour :			
Miscarriage . . .	6·0	0·0	1·2
Premature birth . . .	8·0	2·2	3·0
Stillbirth	3·4	0·0	0·6
Primary uterine inertia . .	6·0	0·0	3·5

vitamins provided by the clinic in charge of the experiment; and a third of 170 women on moderately good diets, who were given advice on how to improve their diets. The supplements were given for four or five months before confinement and for four weeks after the women left the hospital. They consisted of 30 oz. milk, 1 oz. cheese, 1 egg, 1 orange and 3½ oz. canned tomatoes daily with wheat germ and capsules containing viosterol. The course of pregnancy was rated as excellent or good in 66 per cent. of those on the poor diet, 94 per cent. of those receiving supplements and 85 per cent. of those given advice only. The incidence of abnormalities is shown in Table 43.

The birth weights and weights at six months, the rating during the first two weeks and the rating of milk production by the mothers are shown in Table 44.

Table 44.—Weight and Condition of Infants and Lactation of Mothers in Toronto Feeding Experiment

	Poor Diet.	Supplemented Diet.	Good Diet.
Average birth weight	7 lb. 10 oz.	7 lb. 7 oz.	7 lb. 6½ oz.
Average weight at six months	15 lb. 14 oz.	16 lb. 7½ oz.	16 lb. 6 oz.
Infants rated "Good" in first two weeks: per cent.	62·3	90·5	72·2
Lactation: per cent. — Good	42	52	49
Lactation: per cent. — Fair	41	42	43
Lactation: per cent. — Poor	17	6	8

Morbidity during the first six months was much less in infants of the mothers on good diets than in those from mothers on the poor diet. There were three deaths in the poor group; none in the other two.

The third study was made in 1938 and 1939 by a Committee of the People's League of Health. The diets of a large number of women attending antenatal hospital clinics were assessed by questionnaire and, in agreement with what was said above about the diets of the poor, were found to be most frequently deficient in calcium, iron and vitamins A and C. The women were divided by alternate allocation into two groups, excluding those who were not in good health or who were within sixteen weeks of term. Supplements were given to one group of iron, calcium and small amounts of iodine, manganese and copper; vitamins B_1 and B_2 complex, ascorbic acid and halibut liver oil. The subjects totalled 2,510 receiving supplements and 2,511 controls.

There was a difference, claimed as significant, in the incidence of toxæmia (albuminuria) and premature births in favour of the supplemented group.

These experiments are criticised by competent critics as lacking statistical significance. If this be true, it is not surprising because the periods of study have been relatively short and superimposed on long periods of poor or bad feeding. It would be more surprising if there were a dramatic effect on a process like pregnancy, the success of which must obviously depend so largely on the maternal constitution and reserves. And, in any case, the social groups to which reference has so often been made above, themselves provide a lifelong experiment, of which the results are highly significant.

CHAPTER 10—THE FEEDING OF INFANTS

General Considerations : Infants spend their lives almost entirely within the restricted environment of their home. Their chances of survival depend largely on the kind of home into which they are born. Evidence has been presented in Part I, p. 28, to show that the high infant mortality in Scotland is associated with overcrowding in houses that are old and insanitary, often without indoor water supply. Such conditions increase the concentration of infective material in the home and make the hazards to infants acute. It is in these homes, too, that the mothers are ill-nourished and most liable to give birth to premature and weak babies, ill-equipped for the environment into which they are born. A large part of the infant population, therefore, starts life handicapped both by antenatal conditions and by the physical environment after birth.

It is generally recognised that diet has a profound influence on resistance to certain types of infection, mostly of the gastro-intestinal and respiratory tracts. It is extremely important, therefore, considering the conditions just described, to inquire into the feeding of infants in Scotland.

Breast Feeding : It will not be disputed that, provided the milk is adequate in quantity and of good quality, breast feeding is best both for infant and mother. The findings reported in the last two chapters suggest that the diets of mothers may often be inadequate to support a sufficient yield of milk and that, since the vitamin content of milk depends on the mother's diet and reserves, breast milk may often be deficient in essential vitamins. Information has therefore been sought on the incidence of breast feeding in Scotland and the health of Scottish infants.

A number of recent studies of the incidence of breast feeding in England and Scotland are summarised in Table 45.

Table 45.—Incidence of Breast Feeding

	No. of cases.	Per cent. of cases.			Infant mortality rate.
		At 2 weeks.	At 3 months.	At 6 months.	
Liverpool, 1937 [Robinson, 1939.]	439	86–87	48	29	82
Newcastle, 1938 [Spence, 1938.]	1326	—	58	35	66
Ilford, 1938 [Gordon, 1942.]	793	73	—	44	38
Newbiggin, 1940 [Hughes, 1942.]	112	67	32	19	42 (1938)
Edinburgh [Quoted by Spence, 1938.]	3000	87	55	38	61 (1938)
Aberdeen City, 1941–42 [Mackintosh, unpublished.]	1932	75	47	37	72
Aberdeen County, 1941–42 [Mackintosh, unpublished.]	1548	—	52	42	55
St. Andrews Burgh,[1] 1921–37 [Simpson, unpublished.]	1000	93	72	58	48

[1] Only those children who were under observation for three years included.

There is no indication in these sample surveys that the establishment of breast feeding at two weeks is less frequent in Scotland or that lactation is less well maintained than in England. Nor is the incidence of breast feeding higher in the two areas of relatively low mortality, Ilford and Newbiggin, than in the others.

The data collected in Table 46 suggest that there may have been a decline over a period of years, probably not in the rate of establishment but in the maintenance of breast feeding, and this would be in accord with continental records. Yet, during this period there has been a reduction of infant mortality so that, if the decline of breast feeding is real and significant, the effect has been offset by other changes.

Table 46.—Incidence of Breast Feeding at Different Dates

	No. of cases.	Per cent. of cases.		
		At 2 weeks.	At 3 months.	At 6 months.
Liverpool, . . . 1918	294	79	52	33
[Robinson, 1939], . . 1937	439	88	48	29
Ilford, . . . 1920–24	1014	87	—	58
[Gordon, 1942], . . 1938	793	73	—	44
Aberdeen, City, . . 1926	1892	—	—	52
[Report of M.O.H., 1926]				
[Mackintosh, unpublished], 1941–42	1805	—	—	37
St. Andrews Burgh, . 1922–26	575	—	—	62
[Report of M.O.H., 1931], 1927–31	621	—	—	59

More important evidence is afforded by two studies of the incidence of breast feeding in relation to social class (Table 47). The percentage of lactations established is highest in Aberdeen's well-to-do subjects and about equal in Ilford, in both districts, and the Aberdeen poor district. The big difference is in the maintenance of lactation. The well-to-do Aberdeen women, who were possibly of higher economic class than the Ilford good district, were outstandingly successful and the Aberdeen poor district outstandingly unsuccessful.

Table 47.—Incidence of Breast Feeding : Social Classes Compared

	No. of cases.	Per cent. of cases.		
		At 2 weeks.	At 3 months.	At 6 months.
Ilford, 1938—				
Good district	549	79	—	51
Poor district	487	79	—	41
[Gordon, 1942.]				
Aberdeen City—				
Nursing Home . . .	205	87	81	80
Poor district	205	81	47	29
[Mackintosh, unpublished.]				

It appears from these three tables that the endocrine regulation at parturition is sufficient in at least 70 per cent. of cases to initiate lactation. The proportion is certainly higher than 70 and probably at least 90 per cent., because a number of lactations are spoiled by mismanagement at so early a stage that they would not appear at two weeks. This is illustrated by a recent special study of the histories of 100 consecutive infants admitted to Edinburgh Sick Children's Hospital (McNeil, unpublished data). In 28 cases, breast feeding had been given up by three days after birth. At two weeks of age 39 infants, at three months 58, and at six months 76 were no longer breast fed. In 13 out of the 28 cases where breast feeding was given up between birth and three days, the excuse was "lack of milk," but, at that time, lactation is only being initiated and it is impossible to judge whether it would be successful or not.

There is no information to show in what proportion of cases failure to establish lactation can be attributed to the premature ending of pregnancy or

to abnormal conditions of the mother during pregnancy, but McNeil's data suggest that many of these failures are due to misdirection by doctors and nurses who are ignorant of the principles of lactation.

If a satisfactory flow of milk has once been established, either dietary or environmental causes may be responsible for failure to maintain it. It has already been shown that underfeeding and defective diet will affect milk production. There is no doubt, too, that fluctuations in the frequency and duration of breast feeding are sometimes due to extraneous circumstances. The medical profession has not insisted enough on the advantages of breast feeding. There is no provision for employed women, who must work, to feed their infants. Hence breast feeding may be more frequent when unemployment among women is common and show a spurious correlation with periods of adversity. It has been shown by Robinson (1939) in Liverpool that the incidence of breast feeding among women, and especially primiparæ, living in houses of their own was higher than among those living with relatives or in sublet rooms. Similar observations have been made in other areas. It is difficult to distinguish such circumstances from the " lack of will " to suckle with which mothers are so often reproached.

Summing up these findings, it does not at once appear from the samples examined that the incidence of breast feeding is less, or that lactation is less well maintained, in Scotland than in England with its lower infant mortality rate. The effects of poor diet and poor environment appear clearly in the social class difference in the maintenance of lactation demonstrated in Ilford and Aberdeen. Hence, since we have seen that there is much more poverty, and hence poor diet, and bad housing in Scotland, the presumption is that, all over, there will be a smaller proportion of successful lactations. Merely to say that an infant is breast fed is not necessarily to say that it is well fed. Both quantity and quality of milk must also be adequate to meet the requirements of growth and resistance to disease, and we have already seen that the diets of poor mothers are inadequate both in quantity and quality.

The Special Problem of the Premature Infant : Breast feeding is of even greater importance for the premature than for the full-term infant. Growth is most rapid during the last three months of pregnancy. At full-term the infant's tissues are mature to meet the conditions of separate existence ; in particular, the digestive system is ready to deal with food. In the premature infant, the digestive glands are not fully developed and the infant is not ready to be given food by the mouth (McNeil, 1942). The premature infant is also specially susceptible to infection. Hence anything that serves to protect it from the risk of infection and to ease the work of digestion assumes special importance.

For these reasons, panels of wet nurses or breast milk depots have been established in many continental and American cities. The milk is reserved for premature and sick infants. Experience on a small scale in Aberdeen has shown the great value of provision of breast milk for prematures, but there is no organised service of this type in Scotland.

Bottle Feeding : It will be shown in the next chapter that the general decline in infant mortality rate, which began early in this century, coincided with the beginning of systematic efforts to improve the artificial feeding of infants. The risk of infection is much greater when infants are fed on cow's milk which may not be clean from the start and may be further contaminated in handling. Successful bottle feeding, therefore, requires constant and careful attention to hygiene. The danger of infection is minimised by the use of dried milk but, even then, dishes, bottles and teats require sterilisation. Where the facilities are poor and instruction lacking, the danger of infection is greatest.

When the infant is breast fed, its food intake is regulated by the supply ; when it is bottle fed a standard is necessary, and careful instruction is required on how to adjust the amount of food to the needs of the infant. Obviously, where the mother is not under medical supervision or in constant touch with a Welfare Clinic, the adjustment is likely to be faulty.

The change from breast to bottle feeding may give rise to serious trouble also, because the occurrence of constipation and vomiting may be misinterpreted

by the inexperienced mother as meaning that "the baby's digestion is weak," when the real fault is underfeeding. The infant fails to thrive and the feed is further reduced. Finally infection, respiratory or alimentary, supervenes and produces the marasmic infant with an acute infection so frequently seen in the wards of children's hospitals. In a study at the Royal Hospital for Sick Children, Glasgow, covering a year from 1st September 1940 to 1st September 1941, Graham (unpublished data) found that two-thirds of the infants examined (295 cases) did not attain 90 per cent., and one-fifth did not attain even 70 per cent. of their expected weight for age. The death rate in the latter group was 43·8 per cent. Although death in most instances was attributed to infection, the chief underlying cause was probably malnutrition.

It is also true that, where mothers are not under adequate medical supervision or in contact with Welfare Clinics, the need for supplementation of artificial feeds with iron, with cod liver oil to supply vitamins A and D and with fruit juice to provide vitamin C is not recognised. The infant, artificially fed without these supplements, is anæmic, develops rickets, and becomes increasingly susceptible to respiratory and alimentary infections.

The Period from 5 to 12 Months of Age : It is generally agreed that the transition from breast or bottle feeding to a mixed diet should begin not later than the sixth month. It cannot be too strongly emphasised that the change must be to an adequate, balanced diet, providing all the necessary vitamins and minerals. That means a diet including at least a pint of milk daily, with egg or some form of meat, green vegetables and fruit, and with cod liver oil, at least in winter.

The first additions to the milk diet are usually cereal products and in poor families not adequately supervised the process of weaning too often consists of reducing milk in favour of cereals and potatoes, without addition of other protective foods. The undernourishment of bottle-fed babies in the earlier period is often continued and, in the absence of the necessary supplements, deficiency disease inevitably follows. In studies in the Glasgow area between 1938 and 1941 (Hutchison, 1938; McIntosh and Morris, 1941), 70 per cent. of infants attending Welfare Clinics between six and twelve months of age were found to be anæmic. Hutchison found breast-fed infants less anæmic than bottle-fed, probably because a high proportion of the bottle-fed babies were premature and of low birth weight. In Graham's (unpublished) studies at the Sick Children's Hospital, Glasgow, at least one-quarter, and more probably as many as one-half,* of the infants in this age group suffered from rickets.

In the presence of one or more of these conditions, underfeeding, anæmia and rickets, probably associated with deficiency of vitamin A, infection occurs and death is attributed to the infection. No mention is made, even by the pathologist, of the underlying nutritional defects. Yet they are quite well recognised and known to be preventable and, if they were prevented, infection would be less likely to occur and less likely to prove fatal (Graham, 1940).

Hence, when stress is laid on the high infant death rate from infection in Scotland, it must be clearly realised that there are two underlying causes, excessive exposure due to poor housing and overcrowding, and deficient diet leading to lack of resistance.

It is important and urgent that housing should be improved but, as has appeared in studies of rehoused populations, the full benefit will not be reaped unless the diet is also improved. Indeed, it should be possible, without the delay that will be unavoidable in improving housing, to ensure that all infants are fed in accordance with the full energy requirements for their age and with such protective foods and supplements as will ensure prevention of the malnutrition which predisposes to infection.

SUMMARY OF PART THREE

1. The diets of the poor are, in general, inadequate for health. Where a family diet is inadequate for the family as a whole, common experience shows

* According as the method of assessment is radiological or chemical.

that the mother usually suffers most. Special studies of the diets of pregnant women show that poor mothers have insufficient food and that deficiencies of calcium, iron, vitamins A, C and the components of the B_2 complex are common. In Glasgow, such diets have been shown to be associated with prematurity and stillbirth. They must also prejudice the chances of successful lactation and affect the quality of breast milk. Since the proportion of the population living in poverty in Scotland is high, the proportion of mothers inadequately fed will also be high.

2. The correlation of such deficient diets with anæmia in pregnant women is well known. The toxæmias of pregnancy, in general, may be to some extent correlated with poor diet, and the experience of other countries shows that their most serious clinical manifestations can at least be controlled by diet. Three experiments with supplemented diets are discussed, in which the incidence of stillbirths and of prematurity was reduced and the health of the infants improved.
3. Breast milk is the best food for the young infant, but the production of milk in adequate quantities and of high quality depends on the maternal diet. Studies in Scotland show no difference from surveys in England in the percentage of lactations initiated or the average period of breast feeding, but social differences in respect of maintenance of lactation suggest that in Scotland in general (because there is more poverty) there may be an excess of unsatisfactory lactations of short duration.
4. Breast milk is of special importance for the premature infant. Experience has shown its value but there is no organised breast milk service in Scotland.
5. The artificial feeding of infants is not satisfactory and improvements in practice are required.
6. The diet of infants after weaning is often lacking in protective foods.

PART FOUR

THE MEDICAL SERVICES

CHAPTER 11—MOTHER AND CHILD WELFARE SERVICES

Historical : During the second half of last century, the general mortality in Britain declined steadily but infant mortality showed no decrease. It seems surprising that this should be so, over a period which showed a great increase in national wealth, very substantial improvements in sanitation, in medical education and services and in the general standard of living. That no decrease in infant mortality rate occurred would appear to contradict what has been said above about the importance of such improvements for the reduction of infant mortality, but does not, in fact, do so.

There were two main reasons for what happened. First, sanitary improvements were concerned chiefly with public sanitation and the conditions in workshops ; less with domestic conditions and, for instance, not at all with the milk supply. Hence they affected infants less than other age groups. Second, while national wealth grew and the general standard of living rose, there was an increasing concentration of population in towns and cities and an increasing differentiation into rich and poor. By the end of the century, although probably there were nowhere conditions quite as bad as those described in the Reports of the Medical Officer to the Privy Council for 1863 and 1864, and there was a small proportion of the populatiou living under greatly improved conditions, there was a much larger proportion living under bad conditions.

The same tendency has continued into recent times. Titmuss (1943) has shown that in England and Wales between 1911 and 1931, i.e. between the Registrar-General's first and third decennial surveys, in spite of a substantial further rise in the general standard of living and improvement in mortality in all social classes, the gap between the rich and the poor had widened. Relative stability of mortality rates may reflect not so much absence of progress as differentiation, with the improvement in one section of a population offset by deterioration in another. The rich both in England and Scotland have infant mortality rates approaching the limit of what is attainable with present knowledge of how to control the environment. They buy the application of knowledge. The poor in both countries suffer from the failure of society to make that knowledge operative throughout the social structure. And Scotland has now a much higher proportion of poverty in comparison with England or her own past history.

A definite and steady decline of infant mortality in Europe began about the end of last century, first in the more advanced of the continental countries and a little later in England and Scotland. The beginning followed close on the first systematic efforts to improve the artificial feeding of infants. These appeared almost simultaneously in Oslo (1891), Paris (1892) and New York (1893) * in the form of the provision of sterilised milk for babies. Oslo followed this in 1893 with arrangements for the supervision by the Public Health Department of " foster children," by arrangements in 1910 for the care of unmarried mothers, by sickness insurance in 1911 and by a law in 1915 providing allowances to mothers so that they could look after their babies for at least six months.

In 1899 the first milk depot in England was established. The first two in Scotland were opened in Glasgow and Dundee in 1904. In 1905 the first infant

* There are no reliable records to show when and how infant mortality in the United States began to fall.

welfare centre was started by a doctor in Battersea and in 1906 Glasgow appointed a woman doctor to hold infant consultations at the milk depot. Thus mother and child welfare began by tackling the most urgent and obvious problem, the feeding of infants on dirty cow's milk, when that was to be had, or, when it was not, on substitutes which were nutritionally worse, and perhaps little cleaner. As the supply of milk to towns improved, the need for these depots, from the mother's point of view, decreased and attendance dwindled. Unfortunately, the supply improved more rapidly than the quality and the need then became acute for education in the homes on the preparation, which, at first, meant the sterilisation, of feeds.

A parallel line of development, not so closely related in time to the beginning of the decline of infant mortality, took place on the sanitary side. In 1862 the Ladies' Sanitary Reform Association of Manchester appointed " a respectable working woman to go from door to door among the poorer classes of the population to teach and help them as opportunity offered." This example was followed by other towns, slowly at first, and more rapidly in the first five years of this century, so that by 1905 about fifty towns in Great Britain had appointed health visitors, or female sanitary inspectors as many of them were called.

From these dual beginnings, the mother and child welfare service developed, It was first officially subsidised from public funds in 1914.

Comparison with Other Countries : It is difficult and of doubtful value to make comparisons between the present Scottish services and those in other countries because the nature of the services varies and detailed information is difficult to procure, and because in countries with few socio-economic problems, the need for public health services is less. Although the organisation is similar in England and Wales, there are differences in detail. In most other countries the type of organisation is so different that no useful detailed comparison can be made (cf. Appendix 3, which gives a summary of the position in the United States supplied by courtesy of the Director and Assistant Director of the Children's Bureau). In New Zealand, the history has been different from that in this country (Official Year-books, 1926–1941 ; Director-General of Health, 1935 and 1942 ; Woodbury, 1926). The decline of infant mortality began about thirty years earlier but the rate of decline increased early in this century, the acceleration coinciding with the registration of trained nurses (1901), the Midwives' Act (1904), the establishment of the first State (St. Helens) Maternity Hospitals (1905–1907), which were reserved for the wives of less well paid workers, and the foundation by Dr. Truby King (1907) of the Royal New Zealand Society for the Health of Women and Children, whose educational work on infant feeding and nursing must have been of inestimable value. In addition to this voluntary welfare service, New Zealand had in 1939 fifty-three public antenatal clinics for mothers and babies, attached to the State Maternity and Voluntary Hospitals. That represents only one clinic per 560 total births in the country. Five of these clinics are attached to the State Maternity Hospitals which have about 2,000 births per annum, giving an average of about 400 per clinic.

For comparison, Table 48 shows the approximate positions in Scotland and England and Wales in 1937.

It appears from the ratios shown that the services in Scotland lag behind those in England and Wales and that expenditure per birth in Scotland is only two-thirds that in England and Wales.

In so far as comparison can be made between those figures and the data quoted for New Zealand in the preceding paragraph, it might seem as if services were more highly developed here, but it appears that all the public maternity hospitals give antenatal attention to their " booked " cases and that this is additional to the care offered by the fifty-three public clinics to women who will not subsequently be confined in hospital.

The Aims and Facilities of Clinics : Under ideal conditions, the mother and child welfare service would be occupied only with the maintenance of health and the education of mothers to that end. Since, in the past, these mothers have received no health education in school, the teaching of mothercraft by welfare workers is the more difficult and the need for it the more urgent. As

things are, mother and child welfare clinics ought to be even more concerned than they are with the detection and elimination of ill-health. The routine clinical examination at antenatal clinics is designed chiefly from the obstetrical point of view ; such biochemical tests as are used are usually only for albuminuria and syphilis. To illustrate the shortcomings of such a system, it has been shown above that 80 per cent. of stillbirths in booked hospital cases are due to antenatal conditions and outwith the control of obstetricians when the women come to confinement. For this reason alone, more attention should be paid to the nutritional condition during pregnancy. The attention given to anæmia is insufficient, and other deficiency diseases, for instance the angular stomatitis of

Table 48.—Mother and Child Welfare Services in Scotland compared with England and Wales, 1937 (except Expenditure)

	England and Wales.	Scotland.
NUMBERS :		
Live births	610,557	87,810
Total births	629,420	91,384
Equivalent whole-time health visitors	2,919	833
Antenatal clinics	1,701	190 [1]
Child welfare clinics	3,462	272
First visits by health visitors—		
to mothers	217,072	26,102
to infants	594,886	72,517
Total number of mothers who attended antenatal clinics	337,672	31,446
Total number of infants who attended child welfare clinics	381,874	34,504
Expenditure per birth (1935)	£5·2	£3·5
RATIOS :		
Health visitors : births	1 : 216	1 : 110 [2]
Antenatal clinics : births	1 : 370	1 : 481
Child welfare clinics : births	1 : 182	1 : 336
Infants visited per cent. of live births	97·4	82·6
Mothers visited per cent. of total births	34·5	29·7
Infants attending clinic per cent. of live births	62·5	39·3
Mothers attending clinic per cent. of total births	53·6	34·4

[1] Of these 20 are provided by Hospitals and 170 at Child Welfare Centres.

[2] The ratio shown for Scotland is misleading since Queen's Nurses, working in rural areas, act also as Health Visitors and may have a very small number of cases to visit. In the cities the ratio would be much less than in England and Wales.

riboflavin deficiency, may pass through the clinic unrecognised. These and other indices of defective feeding should be used as a guide to the health of mother and fœtus. This would require more and better qualified staff. There is need for qualified dietitians to inquire into and give advice on diet. The same is true, though perhaps to a somewhat less extent, of postnatal and infant welfare clinics. Hence number of clinics alone does not guarantee adequacy of service.

Apart from such desirable additions to the routine, the premises and staff of clinics are often grossly inadequate to the work now undertaken. Often the buildings are ill lighted, badly ventilated and dingy ; insufficiently heated, cramped and without facilities for lectures and demonstrations. Even if the

premises are suitable, it may be necessary, in order to deal with all the subjects, to crowd the clinic sessions beyond the capacity of the staff to do efficient work. Frequently there may be both poor premises and overcrowding.

Under such conditions, it is difficult to envisage the extension of nutritional work that would be desirable. The recognition of deficiency states requires special training; confirmatory clinical or chemical laboratory work may be required. The facilities for consultation with experts and for laboratory work, if required, are poor because medical teaching provides little instruction in the principles of nutrition and there are few clinical laboratories staffed or equipped to deal with nutritional problems.

The Health Visitor : The health visitor is concerned not only with mothers and babies but also with other pre-school children. In many areas she takes a share of school medical work and the care of tuberculosis patients. Her efficiency will depend on the nature of her duties and the number of families allotted to her care. When the child welfare service was started, it was considered that if she could spend at least six half-days weekly on visiting, only one whole-time health visitor was required to 1,000 children under the age of five in compact urban areas. The requirement will obviously depend on the nature of the district and the amount of advice and assistance called for. Experience has shown that if the work is to be efficient, a health visitor in a compact area cannot visit more than a maximum of six homes in one half-day. This corresponds to not more than 500 children below the age of five. Some authorities consider such a district too large. Few, if any, are smaller. If the nurse has school or other duties in addition, her welfare district should be reduced in proportion.

Powers to Provide Additional Services : In addition to the provisions outlined above, powers exist under the maternity and child welfare scheme to provide, where there is need, food for both mothers and children and domestic help. Domestic help is urgently needed in many homes, and the number of cases in which help and food are provided is far below the number in which they are required. Until a long-term policy of social and dietary improvement has had time to show results, the powers that exist should be more often used.

CHAPTER 12—HOSPITAL, MEDICAL AND NURSING SERVICES

It has been found impossible to make all the comparisons desired under this heading because information presented in reports is never complete and different reports select different items for presentation. Points on which it has been possible to make comparison are discussed below.

Confinements in " Institutions " : Tables 49 and 50 show the percentages of births that take place in " institutions," which include hospitals of all types and nursing homes. In 1937 the percentages in Scotland and England and Wales were 37·5 and 35·2 respectively. The percentage in England (36·4) was much higher than in Wales (17·5). Thus Scotland and England are not very different in this respect. For comparison, in U.S.A. in 1939 the percentage was 51·1, varying from 84·6 in the large cities to 21·8 in rural areas. In New Zealand in 1934 it was 74·8.

Hospital Accommodation : From Table 49 it appears that there is no great difference between England and Wales and Scotland in the provision of hospital beds in relation to total births. In Scotland the percentage of births in hospital is greater, and, therefore, there is greater crowding, which appears to be confined to the voluntary hospitals. A comparison with New Zealand shows that New Zealand has roughly 50 per cent. more hospital beds per 1,000 births. The percentage of births in hospital is the same. Assuming the beds to be fully and continuously occupied, this means that, on the average, women confined in Scotland spend only two-thirds as long in hospital as they do in New Zealand.

Table 49—Maternity Beds in Relation to Births

New Zealand, 1934.	State Maternity Hospitals.	Hospital Board Maternity Hospitals or Wards.	Private.	Total Hospital.	Total in "Institutions".[1]
Beds	98	489	1,179	587	1,766
Admissions	2,164	7,010	10,280	9,174	19,454
Births	1,967	6,716	10,029	8,683	18,712
Admissions per bed	22·1	14·3	8·7	15·6	11·0
Births per bed	20·1	13·7	8·5	14·8	10·6

Total births: 25,009. Hospital beds per 1,000 total births: **23·5.** Births in hospital: **34·7** per cent. Births in "Institutions": **74·8** per cent.

England and Wales, 1937.	Local Authority Hospitals or Wards.	Voluntary Hospitals.[2]	Private.	Total Hospital.[2]	Total in "Institutions."
Beds	7,063	2,295	—	9,358	—
Admissions	122,923	44,906	—	167,829	—
Births	—	—	—	—	223,699
Admissions per bed	17·4	19·6	—	17·9	—

Total births: 635,363. Hospital beds per 1,000 total births: **14·7.** Births in "Institutions": **35·2** per cent.

Scotland, 1937.	Local Authority Hospitals or Wards.	Voluntary Hospitals.	Private (approx).	Total Hospital.	Total in "Institutions."
Beds	797	630	540	1,427	1,967
Admissions	13,507	—	—	—	—
Births	11,629	18,608	4,000	30,237	34,237
Admissions per bed	16·9	—	—	—	—
Births per bed	14·6	29·5	7·4	21·2	17·4

Total births: 91,384. Hospital beds per 1,000 total births: **15·6.** Births in hospital: **33·1** per cent. Births in "Institutions": **37·5** per cent.

[1] Excluding a small number of births in general hospitals.
[2] Figures for voluntary hospitals are not complete.

In order to estimate the average length of time spent in hospital per birth, it would be necessary to know how many beds are occupied by antenatal cases and for how long. This information is not available. From common knowledge the average period in voluntary hospitals for a confinement in Scotland does not exceed ten days. Local authority hospitals aim at fourteen days. If it be remembered that the voluntary hospitals deal with a high proportion of abnormal and difficult cases and those in which antenatal care has been inadequate, the position appears all the more unsatisfactory from the point of view of the health of the mother. And, recalling the surroundings to which these women are returning, the poor diet, the overcrowded and unhygienic dwellings into which the infants are being introduced at so early an age, the very short period in hospital may be significant also from the point of view of the survival of the infant. There is no information on the subsequent history of the babies separately to show whether this assumption is justified.

Hospital accommodation should be available for all primigravidæ and for all others with a bad obstetrical history and from unsuitable homes. The percentage of first births in Scotland is 35, and 33 per cent. of total births take place in hospital. Hence the 1937 bed accommodation is not quite sufficient for primigravidæ alone. An increase from 15·6 to 40 or 50 beds per 1,000 births

Table 50.—Live Births that occurred in Hospitals and in Homes, by Attendant, in Cities of Specified Size and in Rural Areas ; United States, 1939

	Live Births.		
	In Hospitals.	In Homes.	
	Per cent.	Medical Attendant. per cent.	No Medical Attendant. per cent.
United States : Total .	51·1	39·1	9·8
Cities of 100,000 or more .	84·6	14·0	1·4
Cities of 50,000 to 100,000.	80·6	17·1	2·3
Cities of 10,000 to 50,000 .	73·3	23·1	3·6
Rural areas (all others) .	21·8	60·9	17·3

would be required on the suggested basis without any allowance for an extended stay in hospital or for more antenatal admissions. Since 1937 the number of beds in hospitals has increased by about 30 per cent. The number in private nursing homes has decreased. There are 300 beds in emergency maternity homes and 1,845 in hospitals. This increase would need to be made permanent and a further increase to treble the 1937 total is necessary.

Domiciliary Midwifery and Maternity Nurses : In New Zealand the proportion of cases delivered by midwives alone is very low, less than 3 per cent., including district cases under the supervision of the State Maternity Hospitals.

In contrast with less than 3 per cent. in New Zealand, 24 per cent. of births in Scotland are attended by midwives alone and the proportion of midwives to total births was 1 to 65 in 1937.

In the same year in England (excluding London) midwives employed under the Midwives Act were responsible for 24 per cent. of the total confinements. This takes no account of those practising independently, so that the proportion of births attended by midwives alone must be much higher in England than in Scotland. The proportion of midwives, practising under the Act, to total births was 1 : 85 in 1937 and of midwives who had given notice of the intention to practise 1 : 34 in 1936 in England and Wales. Later data are not available.

The supply of trained maternity nurses in New Zealand is very high, so that where the woman is confined at home by her family doctor (23 per cent. of the total) a fully qualified nurse is also in attendance. Altogether New Zealand

had slightly more than one practising midwife or fully qualified maternity nurse for every twelve births in 1934. It has not been found possible to make a direct comparison with England and Wales or Scotland, but it is unlikely that the supply of practising midwives and maternity nurses would approach this standard.

The Training of Midwives and Maternity Nurses : The time occupied in the training of midwives and maternity nurses and the general scheme of training are practically the same in Scotland, England and Wales and New Zealand. The conditions of training in Scotland are not always good. Student midwives and nurses are used largely in the service of the hospital and the allowance of free time for study is inadequate. In the wards of some hospitals where medical students are also taught, nurses compete against the students for the limited amount of clinical material available. Little attention is paid to the rules laid down by the Central Midwives Board (Rule C. 32 (m)) for training in the hygiene and feeding of infants.

Health visitors have only six months' special training, and the course should be both extended and improved. Consideration should be given to the advisability of developing a service of specialist health visitors on the lines of the service first organised by Dr. Truby King in New Zealand, to which reference has been made on p. 62.

Medical Teaching : The standard of teaching of medical students, and post-graduate instruction, at least as far as the principles of child health are concerned, should be much higher. Sweden, for instance, had the first Chair of Pædiatrics in the world, founded in 1845, and instruction of medical students in this subject was made compulsory in that year (Schiøtz, 1934 ; Jundell, 1939). It was followed by the first American Chair in New York in 1860 (Jacobi, 1911). Pædiatrics has been taught for many years as a major subject in all advanced countries except this, and the children's doctor has been a recognised part of medical systems in which there are more specialists and fewer general practitioners than here. In most British medical schools, pædiatrics is a minor subject ; of Scottish medical schools, only Glasgow * has implemented the recommendations made by the General Medical Council in 1932 that infant hygiene and diseases of children should be included in the subjects for final examinations.

The Reports on which these recommendations were based considered neglect of the study of children's diseases to be a serious defect in the medical curriculum and the attention given to the subject of infant hygiene to be " farcical." While this persists, the training of general practitioners to take care of child health will remain grossly unsatisfactory.

There is an equally serious lack of appreciation of the importance of instruction in the principles of nutrition and their clinical application. In the United States in 1939 (Rose, 1935 ; Committee of American Dietetic Association, 1939), 71 out of 82 medical schools provided courses of instruction in nutrition, conducted by Professors of Nutrition, Medicine, Biochemistry and Physiology or by dietitians. A doctor's degree in nutrition was first granted by Columbia University in 1932 and, by 1935, more than 300 Universities and Colleges were training teachers, hospital dietitians and dietitians for extension work under the Department of Agriculture and for welfare and relief work throughout the States. America has also a wide and richly endowed system of Research Foundations. In contrast with this, in this country, there are only four institutions giving recognised diploma courses in dietetics. A few hospitals train dietitians in hospital work. There is no organised University teaching of nutrition.

But the fault goes deeper than the lack of text-book teaching and examinations. There is also a general lack of facilities for teaching. In children's hospitals, healthy infants and children are not to be found and, although the theory of infant health and infant diet may be taught there, practical and clinical instruction cannot be given. Yet it is as important to know and understand the healthy child as to recognise disease, and child welfare centres, especially those attached to hospitals, would provide abundant clinical material. Here

* Edinburgh has now implemented the recommendations.

and there, in both England and Scotland, attempts are being made to establish such " well baby " clinics but medical teaching in this, as in other branches of medicine, has been too long occupied with disease and has lacked contact with health.

The ideal teaching unit would be a child welfare clinic on the same site as a maternity and a children's hospital. The same medical staff should be available for service in both the child welfare clinic and the hospitals.

Again there is no evidence to show that England and Wales enjoy any better placing in this respect than Scotland.

The Co-ordination of Services : At the present time medical and nursing practice in infant health is divided between three services : the child welfare service, with its medical personnel and health visitors ; the family doctors ; and the pædiatricians preoccupied with the problem of disease in hospitals, but here and there taking a small part in the health side in maternity hospitals and child welfare centres attached to these institutions. The liaison between the three services is weak ; personal contacts between the doctors engaged in them hardly exist. Family doctors do not receive a proper training in the problems of infant health ; the work of child welfare doctors is monotonous and apt to lose interest because contact is not maintained with sick children ; and the hospital doctors, expert in problems of disease, have little experience either of home conditions or of the work of the child welfare clinics.

This is obviously a most unsatisfactory system, both inefficient and wasteful. Reorganisation is under discussion. It will fail of its main purpose, to promote child health, if it does not provide the means for satisfactory clinical teaching. It will fail also if it does not ensure much closer contacts between the three services.

SUMMARY OF PART FOUR

1. Scotland has lagged behind in the provision of maternity and child welfare services. Clinic premises are often poor, ill-equipped and overcrowded. Nutritional supervision is inadequate. Liaison between the hospitals, the family doctors and the child welfare service is poor.
2. Health visitors have usually much larger districts than they can efficiently manage.
3. Powers to supply extra food and domestic help are not sufficiently used by Local Authorities.
4. The proportion of births in hospitals and nursing homes is much higher in New Zealand and the United States than in England and Wales or Scotland. There is no difference between New Zealand and Scotland in the proportion of births in hospitals, but the ratio of maternity beds to confinements in hospital is 50 per cent. higher in New Zealand. The shortage in Scotland is shown chiefly in crowding in the voluntary hospitals.
5. In New Zealand only about 3 per cent. of confinements are conducted by midwives alone as compared with 24 per cent. in Scotland. The number of highly trained midwives and maternity nurses is so high that practically every birth in the country has a trained nurse in attendance.
6. The provisions for the training of midwives and maternity nurses in Scotland are similar to those in England and Wales and New Zealand, but the conditions of training are unsatisfactory.
7. There is, in Britain, practically no instruction in medical schools in the principles of child health. In countries with low infant mortality rates, such instruction has been part of the routine for from fifty to nearly one hundred years. There is an equally serious lack of instruction in the principles of nutrition and their clinical application. There are neither enough teachers nor adequate facilities for teaching.
8. The co-ordination of the three services which care for mothers and children is extremely poor and the replanning of medical services in general should include measures to improve contact and collaboration.

APPENDIX 1—INFANT MORTALITY IN SCOTLAND

Table 51—Infant Mortality Rate : Large Burghs

1929–33		1934–38		1939–41	
Dunfermline	57	Dunfermline	58	Falkirk	60
Kirkcaldy	67	Kirkcaldy	64	Kirkcaldy	62
Falkirk	71	Falkirk	65	Edinburgh	64
Edinburgh	74	Edinburgh	66	Dunfermline	68
Ayr	75	Arbroath	67	Rutherglen	69
Rutherglen	76	Rutherglen	75	Perth	70
Inverness	76	Airdrie	75	Aberdeen	74
Arbroath	77	Aberdeen	76	Motherwell & Wishaw	76
Clydebank	77	Motherwell & Wishaw	76	Dundee	77
Perth	79	Inverness	76	Arbroath	78
Stirling	79	Dundee	77	Ayr	78
Kilmarnock	81	Perth	78	Kilmarnock	80
Hamilton	84	Dumbarton	78	Clydebank	82
Motherwell & Wishaw	86	Port Glasgow	81	Stirling	84
Dumbarton	87	Ayr	82	Inverness	85
Aberdeen	88	Stirling	82	Greenock	87
Port Glasgow	88	Clydebank	83	Dumbarton	88
Dumfries	91	Hamilton	85	Coatbridge	91
Airdrie	93	Kilmarnock	87	Dumfries	92
Paisley	94	Paisley	89	Airdrie	92
Dundee	96	Greenock	91	Hamilton	94
Greenock	102	Coatbridge	91	Glasgow	95
Coatbridge	104	Dumfries	96	Port Glasgow	105
Glasgow	104	Glasgow	99	Paisley	108

Table 52—Infant Mortality Rate : Counties, excluding Large Burghs

1929–33		1934–38		1939–41	
Zetland	40	Zetland	39	Zetland	34[1]
Orkney	45	Bute	44	Peebles	41[1]
Bute	52	Peebles	45[1]	Sutherland	47[1]
Sutherland	54	Orkney	48	Bute	48[1]
Inverness	55	Inverness	48	Inverness	48
Ross and Cromarty	55	Ross and Cromarty	49	Orkney	49
Argyll	56	Argyll	49	Roxburgh	51
Perth	57	Sutherland	52	Argyll	52
Berwick	57	Roxburgh	53	Ross and Cromarty	54
Peebles	58	Selkirk	54	Perth	56
East Lothian	59	Perth	55	Berwick	57
Kirkcudbright	64	Kinross	55[1]	Selkirk	57[1]
Kinross	65[1]	Kirkcudbright	57	Renfrew	59
Moray	65	East Lothian	58	Caithness	59
Roxburgh	66	Berwick	59	Banff	60
Dumfries	66	Angus	62	Aberdeen	61
Selkirk	67	Renfrew	63	Kirkcudbright	62
Kincardine	67	Midlothian	64	Angus	62
Angus	69	Kincardine	64	East Lothian	63
Midlothian	70	Aberdeen	65	Wigtown	63
Renfrew	71	Caithness	65	Midlothian	67
Aberdeen	74	Fife	65	Dunbarton	67
Fife	74	Dunbarton	65	Fife	68
Ayr	74	West Lothian	65	Ayr	68
Stirling	75	Nairn	66[1]	Stirling	68
West Lothian	76	Moray	68	Kinross	69[1]
Banff	77	Banff	68	West Lothian	70
Caithness	81	Stirling	68	Nairn	70[1]
Dunbarton	83	Dumfries	69	Moray	71
Nairn	83[1]	Wigtown	73	Kincardine	72
Lanark	83	Lanark	74	Dumfries	72
Clackmannan	83	Clackmannan	74	Lanark	81
Wigtown	86	Ayr	77	Clackmannan	83

[1] Based on less than 1,000 births.

Table 53—Death Rate 1–12 Months : Large Burghs

1929–33		1934–38		1939–41	
Dunfermline	25	Kirkcaldy	24	Kirkcaldy	26
Kirkcaldy	29	Dunfermline	27	Dunfermline	27
Perth	34	Falkirk	28	Falkirk	30
Falkirk	36	Edinburgh	31	Edinburgh	31
Arbroath	39[1]	Stirling	31	Rutherglen	31
Edinburgh	40	Arbroath	34	Arbroath	34
Ayr	42	Rutherglen	35	Aberdeen	34
Clydebank	42	Inverness	38	Perth	35
Stirling	44	Perth	39	Dundee	35
Inverness	45	Aberdeen	41	Inverness	36
Dumbarton	46	Dundee	41	Clydebank	38
Hamilton	46	Ayr	42	Kilmarnock	42
Motherwell & Wishaw	47	Kilmarnock	42	Ayr	43
Rutherglen	48	Clydebank	43	Stirling	45
Kilmarnock	48	Dumbarton	43	Motherwell & Wishaw	46
Airdrie	50	Motherwell & Wishaw	43	Dumbarton	46
Aberdeen	52	Airdrie	43	Airdrie	46
Port Glasgow	53	Hamilton	46	Greenock	48
Paisley	54	Port Glasgow	46	Dumfries	49
Dundee	56	Dumfries	51	Coatbridge	50
Dumfries	57[1]	Paisley	51	Hamilton	53
Greenock	63	Coatbridge	51	Glasgow	53
Coatbridge	64	Greenock	57	Port Glasgow	54
Glasgow	67	Glasgow	59	Paisley	58

[1] 1931–33 only.

Table 54—Death Rate 1–12 Months : Counties, excluding Large Burghs

1931–33		1934–38		1939–41	
Zetland	12[1]	Zetland	12	Bute	15[1]
Peebles	16[1]	Bute	15	Zetland	16[1]
Berwick	17	Selkirk	16	Inverness	17
Orkney	22[1]	Inverness	17	Berwick	19
Roxburgh	22	Roxburgh	19	Peebles	20[1]
Argyll	23	Berwick	19	Sutherland	21[1]
Inverness	24	Sutherland	20	Argyll	21
Sutherland	26	Peebles	20[1]	Roxburgh	22
Perth and Kinross	26	Orkney	21	Kirkcudbright	23
Selkirk	27[1]	Ross and Cromarty	21	Orkney	23
Moray and Nairn	29	Argyll	21	Ross and Cromarty	24
Ross and Cromarty	30	Perth and Kinross	23	Renfrew	25
Kincardine	30	Kirkcudbright	23	Perth and Kinross	26
Angus	31	East Lothian	23	Selkirk	26[1]
East Lothian	31	Angus	23	Wigtown	28
Bute	32[1]	Kincardine	25	Aberdeen	28
Dumfries	32	Fife	26	East Lothian	28
Midlothian	34	Midlothian	28	Midlothian	28
Renfrew	34	Clackmannan	28	Angus	29
West Lothian	34	Renfrew	29	Fife	30
Kirkcudbright	34	Dunbarton	30	Dunbarton	31
Ayr	36	West Lothian	30	Caithness	31
Aberdeen	37	Moray and Nairn	31	Kincardine	32
Fife	38	Banff	31	Banff	33
Stirling	38	Dumfries	32	Stirling	34
Wigtown	40	Caithness	32	West Lothian	34
Banff	41	Aberdeen	32	Moray and Nairn	34
Dunbarton	43	Stirling	33	Dumfries	34
Caithness	45	Wigtown	33	Ayr	36
Lanark	46	Ayr	36	Lanark	39
Clackmannan	49	Lanark	37	Clackmannan	42

[1] Based on less than 1,000 births.

Table 55—Neonatal Death Rates : Large Burghs

1929–33		1934–38		1939–41	
Rutherglen	28	Dunfermline	31	Motherwell & Wishaw	30
Inverness	31	Airdrie	32	Falkirk	30
Dunfermline	32	Arbroath	33	Edinburgh	33
Ayr	33	Motherwell & Wishaw	33	Ayr	35
Kilmarnock	33	Greenock	34	Perth	35
Edinburgh	34	Port Glasgow	35	Kirkcaldy	36
Clydebank	35	Dumbarton	35	Rutherglen	38
Dumfries	35[1]	Edinburgh	35	Kilmarnock	38
Stirling	35	Aberdeen	35	Greenock	39
Falkirk	35	Dundee	36	Stirling	39
Port Glasgow	35	Falkirk	37	Aberdeen	40
Aberdeen	36	Inverness	38	Coatbridge	41
Glasgow	37	Paisley	38	Hamilton	41
Hamilton	38	Hamilton	39	Dunfermline	41
Kirkcaldy	38	Perth	39	Dumbarton	42
Motherwell & Wishaw	39	Clydebank	40	Dundee	42
Greenock	39	Glasgow	40	Glasgow	42
Coatbridge	40	Kirkcaldy	40	Dumfries	43
Dundee	40	Ayr	40	Arbroath	44
Paisley	40	Coatbridge	40	Clydebank	44
Dumbarton	41	Rutherglen	40	Airdrie	46
Arbroath	42[1]	Dumfries	45	Inverness	49
Airdrie	43	Kilmarnock	45	Paisley	50
Perth	45	Stirling	51	Port Glasgow	51

[1] 1931–33 only.

Table 56—Neonatal Death Rates : Counties, excluding Large Burghs

1931–33		1934–38		1939–41	
Zetland	23[1]	Peebles	25[1]	Zetland	18[1]
Bute	25[1]	Orkney	27	Peebles	21[1]
Orkney	26[1]	Zetland	27	Orkney	26
Kirkcudbright	26	Argyll	28	Sutherland	26[1]
Sutherland	26[1]	Ross and Cromarty	28	Banff	27
Ross and Cromarty	27	Bute	29	Caithness	28
Inverness	29	Inverness	31	Roxburgh	29
East Lothian	29	Sutherland	32	Ross and Cromarty	30
Perth and Kinross	31	Perth and Kinross	32	Selkirk	31[1]
Aberdeen	35	Caithness	33	Argyll	31
Argyll	35	Aberdeen	33	Inverness	31
Dumfries	36	Renfrew	34	Perth and Kinross	31
Midlothian	36	Kirkcudbright	34	Ayr	32
Renfrew	36	Roxburgh	34	Angus	33
West Lothian	36	Dunbarton	35	Aberdeen	33
Fife	37	East Lothian	35	Bute	33[1]
Kincardine	37	Stirling	35	Renfrew	34
Roxburgh	37	West Lothian	35	Stirling	34
Ayr	37	Midlothian	36	Wigtown	35
Banff	37	Dumfries	37	East Lothian	35
Angus	37	Lanark	37	Dunbarton	36
Clackmannan	37	Moray and Nairn	37	West Lothian	36
Dunbarton	38	Banff	37	Moray and Nairn	37
Stirling	39	Selkirk	38	Dumfries	38
Berwick	39	Fife	39	Berwick	38
Moray and Nairn	39	Angus	39	Fife	38
Lanark	40	Kincardine	39	Kirkcudbright	39
Selkirk	40[1]	Wigtown	40	Midlothian	39
Wigtown	41	Berwick	40	Kincardine	40
Caithness	44	Ayr	41	Clackmannan	41
Peebles	44[1]	Clackmannan	46	Lanark	42

[1] Rate based on less than 1,000 births.

Table 57—Stillbirth Rates : Large Burghs

1939–41			
Arbroath	32	Greenock	41
Motherwell & Wishaw	33	Stirling	42
Kilmarnock	35	Airdrie	42
Aberdeen	36	Dunfermline	42
Port Glasgow	36	Paisley	43
Perth	37	Glasgow	44
Clydebank	38	Hamilton	45
Dumfries	38	Dundee	46
Rutherglen	38	Falkirk	47
Dumbarton	39	Coatbridge	48
Edinburgh	39	Kirkcaldy	48
Inverness	40	Ayr	49

Table 58—Stillbirth Rates : Counties, excluding Large Burghs

1939–41			
Bute	21[1]	Fife	39
Orkney	30	Stirling	40
Selkirk	30[1]	Ayr	41
Kirkcudbright	30	Renfrew	41
Wigtown	33	West Lothian	42
Moray and Nairn	33	Peebles	43[1]
Aberdeen	35	Dumfries	43
Angus	36	Lanark	44
Ross and Cromarty	36	Midlothian	45
Zetland	37[1]	Roxburgh	46
Caithness	37	Clackmannan	46
East Lothian	37	Argyll	46
Berwick	38	Sutherland	47[1]
Kincardine	38	Dunbarton	48
Inverness	38	Banff	48
Perth and Kinross	38		

[1] Based on less than 1,000 births.

APPENDIX 2—THE EFFECT OF DIET ON FŒTAL AND INFANT MORTALITY IN ANIMALS

Imperial Bureau of Animal Nutrition—21st September 1942

FARM ANIMALS

Fœtal and infant mortalities are high in farm animals. In a first-class dairy herd, stillbirths, over a period of two years, were 1·9 per cent. of the total births and mortality during the suckling period was 3·7 per cent. of live births. The rates would be considerably higher in the average herd. The loss of lambs varies from over 20 per cent. on poor grazings to between 5 and 10 per cent. under conditions of good management and good feeding. In pigs, even under good conditions, stillbirths average about 7 per cent. of total births and about 20 per cent. of those born alive die during the suckling period. The death of chick embryos during incubation of the eggs from hens on " normal " diets is 20 to 40 per cent. of fertile eggs and in eggs from hens on deficient diets all embryos may die or those thatched out be too weak to survive.

It is recognised that the magnitude of these losses is to a large extent

dependent on diet. The known facts regarding the effect of diet are briefly summarised as follows :

Energy Supply : An adequate supply of energy is essential to successful reproduction. Acute shortage will cause interruption of pregnancy and abortion. Farm animals are usually fed so that they improve in condition during pregnancy, but this is not always true for ewes ; and it has recently been shown that underfeeding, with the consequent mobilisation of body fat, is the main cause of ketosis in pregnant ewes. Fatty infiltration of the liver occurs, and the condition is one of the main causes of fœtal and maternal mortality in flocks on poor pasture. This pregnancy toxæmia of ewes is thought by some to resemble pregnancy toxæmia in women.

During lactation, cows are normally stall fed according to milk yield, or pastured on good grass with concentrate supplements, but ewes are not always given supplementary feeding in proportion to the number of lambs, and the supply of milk for the lambs may therefore be inadequate. If they have been underfed during pregnancy, lactation may fail. Sows are usually inadequately fed during lactation and lose heavily in condition. Such treatment is certain to restrict milk production and probably explains part of the high mortality during the suckling period. The smaller the litter the faster, on the average, do the pigs grow and the larger is the percentage surviving. On the other hand, sows that become overfat during pregnancy, on unbalanced rations of high carbohydrate content, produce small litters of poor viability.

Protein : There are optima for the protein content of the diet during both pregnancy and lactation. The number, size and viability of the young at birth are affected and the yield of milk is largely dependent on an adequate supply of protein. If the supply is inadequate, the yield falls. Composition is not affected.

The yield of eggs depends on adequate supplies of energy and protein. Composition is not affected.

Calcium and Phosphorus : Adequate supplies of both calcium and phosphorus are necessary for the birth of normal young. Maternal reserves may be adequate to meet the demands of one pregnancy and lactation, but where reproduction is continued on deficient diets the results become steadily worse. In pigs, for instance, the effect of calcium deficiency (pig rations are not deficient in phosphorus) is cumulative from litter to litter and generation to generation. The number of pigs born dead increases rapidly and the number of deaths from bone fractures rises progressively. This may be one of a number of possible causes contributing to the deterioration of breeding records of sows with increasing age. The sow's best performance is at the early age of two to three years.

The supply of calcium and/or phosphorus also limits milk production and so may determine survival of the young after birth.

In poultry too, calcium and phosphorus are important. In the long run, deficiency and depletion of the hen's reserves will cause arrest of egg laying, but before then, deficiency of calcium will affect the thickness of the shell and this is believed by some observers to have a direct effect on the hatchability of the egg.

Iron : Anæmia in the mother does not appear to affect fertility but it does profoundly affect not only the viability of the young during the suckling period but also the health and development at much later ages. In pigs, the hæmoglobin at birth depends on that of the parent sow. A physiological reduction occurs as in all mammals and the degree of anæmia developing depends on two main factors, the supply of iron to the sow and exposure to sunlight. The hæmoglobin value at two weeks of age is closely correlated with the mortality and the rate of gain in weight during the suckling period and, what is more surprising, the hæmoglobin value at eight weeks is correlated with the subsequent progress, in bacon pigs, to slaughter at 90 kg. live weight. In a survey of several thousand pigs, only 64 per cent. of those anæmic at eight weeks were classed as completely healthy at slaughter, compared with 92 per cent. of those not anæmic at weaning. The maintenance of a normal hæmoglobin level in the sow is essential to continued successful reproduction. An anæmic sow, rebred

without change of diet, produced a large litter of which only one was weaned. Iron deficiency may therefore also contribute to the deterioration of breeding records with age.

In poultry too, iron is of importance. The hæmoglobin level of the hen's blood rises and falls with the rate of egg laying. A severe anæmia occurs in embryo chicks, responsible for a high mortality at an early stage of development. It is not known exactly how these two facts are correlated but some correlation would be expected to exist.

Trace Elements : Deficiency of iodine results in abnormal development of the fœtus (apart from goitre) and a high proportion of stillbirths. Naturally occurring deficiencies are reported for cattle, sheep and pigs. Manganese is also indispensable and naturally occurring deficiency affects the development of poultry. It is responsible for perosis in the growing bird and for a late peak in embryo mortality.

Vitamin D : It is known that deficiency of vitamin D affects the viability of the mammalian fœtus and the chick embryo, but whether this effect is in any way apart from its effect on calcium and phosphorus metabolism is not clear.

Vitamin A : In cattle, sheep and pigs, severe deficiency of vitamin A results in the birth of premature, dead or weak calves, which may be blind and which do not usually survive more than a few days. The birth is described of pigs that were blind, some of them without eyeballs, with misplaced kidneys, cleft palate and hare lip, and other deformities.

The vitamin A content of milk depends on the diet of the lactating animal and an adequate supply is essential to the survival of the young.

Vitamin E : It has frequently been suggested that deficiency of vitamin E may be responsible for failure of gestation in farm animals, but there is no conclusive evidence to show that vitamin E deficiency occurs in mammals other than the rat. Resorption of fœtuses does occur, at least in pigs, but since that can occur in the rat as the result of deficiency of vitamin A and probably from other causes, it cannot be regarded as specific for vitamin E deficiency. That does not mean that vitamin E is not required for mammalian development in general. The difference between the rat and farm animals may lie in ability to synthesise or to transmit vitamin E across the placenta. There is no information to show. Vitamin E is required for development of the chick embryo and embryos from hens on a deficient diet die at an early stage of development.

Vitamin B_1 : There is no evidence to show that vitamin B_1 deficiency has any effect on gestation or lactation beyond that of the resultant anorexia and inanition.

Riboflavin : The rôle of riboflavin in mammalian embryonic development is not known but, since it is essential at all stages of life after birth, it is unlikely that it should not affect the earlier stages.

Deficiency of riboflavin is one of the common and best-known causes of embryo mortality in chicks. The time of death depends presumably on the degree of shortage. Chicks dying in the later stages show the nerve lesions typical of the deficiency. Chicks that hatch continue to show a high mortality rate during the first week of life, even on a normal diet.

LABORATORY ANIMALS

All the statements given above for farm animals have been amply proved in experiments on laboratory animals. Deprivation of food causes interruption of pregnancy and abortion ; it limits or prevents production of milk. The protein requirement during gestation is higher than the usual adult requirement and during lactation it is higher still. On a diet deficient in calcium (half the " normal " supply) rats will produce a first litter fairly successfully but, of the second generation, only a small proportion will bear young and none of the young will be reared. Rats on a diet deficient in iron will also produce one litter successfully but a second litter will cause a severe anæmia both in mother and young. The young die usually within one or two days of birth. Second generation rats on iron-deficient diet give similar histories. They bear young, but many

are stillborn and only a few are reared. Iodine and manganese are also essential. The effects of deficiency of iodine are similar to those in other mammals. Rats from mothers on diets deficient in manganese are born normal but too weak to suckle.

It has also been found that rats on diets deficient in magnesium bear normal young but are unable to suckle them. Such young as survive show the characteristic signs of vasodilatation and hyper-irritability. The possibility of magnesium deficiency in farm animals does not appear to have been considered except in the case of milk tetany in calves.

The effect of deficiency of vitamin A on reproduction in the rat has not been so much studied as might be expected. Defects in eye development, tooth development and a high incidence of congenital diaphragmatic hernia have been reported. Pregnant rats show prolonged gestation, difficult delivery and a high percentage of stillbirths. Newton's data are as follows :

Table 59—Effect of Vitamin A Deficiency on Parturition in the Rat

	No. of rats.	Delivery.				Total born in normal delivery.	Dead fœtuses in these.
		Normal.	Delayed.	Difficult.	Uncompleted.		
Deficient diet . .	98	31	10	12	45	555	22
Deficient diet plus vitamin A . . .	21	18	3	—	—	196	7
Normal diet . .	26	22	1	—	3	226	3

Experimental vitamin E deficiency has been intensively studied in rats and, although there is at present no reason to consider this deficiency of primary importance to other mammals, yet it affords certain points of interest that may be of wider importance. The effect of vitamin E on the development of the rat embryo is exerted on the embryo side of the fœtal membranes and transmission across the placenta is therefore necessary. It has recently been shown that transmission becomes increasingly difficult with age and that fertility at different ages corresponds with power of transmission. This raises the general question of whether transmission of other substances across the placenta also varies with age, for the rat is not peculiar in showing an early maximum fertility. The same has been shown to be true of the pig and appears, according to Burns, to be true of women, or at least of women subsisting on poor diets.

The rôles of the several constituents of the B complex have not been studied separately but the first-year records of rats reared on a diet deficient in the entire complex showed only small litters and none were reared.

It has recently been discovered that rats reared on a rachitogenic diet of high calcium content, supplemented by viosterol to prevent rickets, show a high incidence of resorptions, atrophic fœtuses and skeletal deformities of a definite pattern, including shortening of the mandible, shortening or absence of limb bones and syndactylism. Other changes were seen with less frequency. The abnormalities were completely prevented by giving liver or an alcoholic extract of liver.

Guinea-pigs on a diet of low vitamin C content do not produce living young. The fœtuses are aborted or resorbed. This is attributed to failure of development or degeneration of the Graafian follicle.

With the possible exceptions of vitamin E and manganese all the findings reported above are directly applicable to human beings. Women on poor diets are liable to suffer from deficiency of any one or more than one of the constituents discussed.

An interesting study has recently been made of the effect of early and delayed breeding on the fertility and reproductive performance of rats.

Breeding late in the life of the female rat reduces her reproductive ability by increasing the interval between litters and reducing the size of the litters.

Females that produce the first litter when they are old have difficulty in delivering their young, and generally are poor mothers.

Females that are permitted to reproduce and lactate at a young age are not so productive as are animals that have some further development following puberty before they begin producing and raising young. Although the difference is not large, the interval between litters is longer and the size of the litters is smaller for those females that reproduce and lactate early in life.

ADDENDUM, JULY 1943

As this Report is being completed, there is in the press (Richards, *Brit. Med. J.*, 1943) an account of a breeding experiment with rats at the Rowett Research Institute, designed to determine the effect on reproduction of a poor human diet with and without supplements. The supplements tested were milk, calcium, vitamin B_1 and yeast, separately or in different combinations. The results are shown in the following two tables.

Table 60—Showing Breeding Results for 3 Consecutive Matings

Dietary Supplements.	Litters born. / Litters of 8 reared.	Average No. born alive per litter.	Average No. born dead per litter.	Average No. reared per litter born.	Average weaning wt. per rat (litters of 8). g.	Weights of Does. g.	
						At first mating.	After third lactation.[1]
—	24/4	6·9	0·8	5·4	33·6	185	228
Milk . .	30/14	8·8	0·5	6·3	39·1	186	255
Ca . .	27/13	8·6	0·3	6·9	35·1	202	239
Ca+milk .	21/14	9·2	0·5	7·4	40·5	196	273
Aneurin. .	27/15	8·0	1·9	6·2	32·2	186	214
Aneurin+milk	27/14	8·7	0·4	6·8	38·7	185	243
Ca+aneurin .	33/17	7·9	0·6	6·5	36·5	193	258
Ca+aneurin +milk .	27/18	9·9	0·4	7·1	41·9	186	268
Ca+yeast .	30/25	9·8	0·6	7·4	40·9	206	266
Ca+yeast +milk .	33/23	9·8	0·8	7·0	45·8	209	302

[1] After rearing litters of 8.

Table 61—Deaths during Suckling Periods

Supplements.	No. of Does.	No. of Young.		Deaths during Suckling.			
		Born alive.	In reduced litters (after 24 hours).	2–6 days.	7–11 days.	12-23days.	Total.
—	18	431	356	20	3	16	39
Ca . .	16	425	354	8	3	0	11
Aneurin. .	18	451	361	7	0	3	10
Ca+aneurin .	20	529	416	9	1	0	10
Ca+yeast .	21	615	458	4	0	0	4

These records show clearly the importance of diet in determining the breeding performance of animals in controlled environment and indicate the large part it may possibly play in the problem of infant mortality and maternal health in the human population.

APPENDIX 3—HEALTH SERVICES IN THE U.S.A.

U.S. Department of Labor, Children's Bureau, Washington

December 17, 1942.

Miss Lenroot has received your letter requesting information regarding measures directed toward the lowering of infant mortality that have been adopted in the United States, and has requested me to send you material on this subject.

One of the early studies of the U.S. Children's Bureau was of the factors associated with infant mortality. The findings of this study are summarised in the publication *Causal Factors in Infant Mortality,** a copy of which I am sending you. While this study was published in 1925, we have no reason to believe that the conclusions are not, for the most part, applicable to-day. The relative importance of some of the factors has changed, however. For example, we do not see the same influence of seasonal conditions upon mortality from gastric and intestinal diseases, since there is now more widespread knowledge of correct methods of artificial feeding. For the same reason, it is doubtful whether there is now as marked a difference in the mortality of breast-fed and artificially-fed infants.

Gastric and intestinal diseases were formerly the chief cause of death in infants during the second to twelfth months. In the early years of the present century activities directed toward lowering infant mortality were, therefore, chiefly directed toward improvement in infant feeding. Milk stations, at which prepared feedings were distributed for artificially-fed infants, were organised in a number of cities. It was soon learned, however, that more could be accomplished by teaching the mother how to prepare the feedings and how to care for her infant, and by providing medical supervision for the mother during pregnancy and for the child after birth. Consequently, it has become customary to provide health services for expectant mothers and for children under school age in the form of prenatal clinics and child health clinics, with services of public health nurses both in the clinics and at home visits.

The marked decrease in infant mortality, especially from gastric and intestinal diseases, that occurred previous to 1935, cannot be attributed entirely to the development of special health services for mothers and children, which up to that time existed chiefly in the larger cities. A number of general factors undoubtedly played an important rôle, such as improved sanitation and control of milk and water supplies, increased medical knowledge of the correct care and feeding of infants, and general dissemination of ideas of personal hygiene and particularly of child hygiene. Probably the most important factors have been the increased use of pasteurized or evaporated milk in artificial feedings and the education of mothers as to the importance of boiling all fresh milk used for infant feeding.

In 1935 Congress passed the Social Security Act. One title of this Act authorized the appropriation of Federal funds for allotment to the States for the development of maternal and child health services in the States, especially in rural areas and areas of special need. This Act has greatly stimulated the development of such services. The booklet *Maternal and Child-Health Services Under the Social Security Act* outlines the development of this program from 1936–39. It also describes the type of services rendered. Of course, not all of the services described are as yet widely available throughout the country. The extent to which the various services are now provided is discussed in the folder *Facts About Child Health,* on pp. 9–11.

The measures taken to reduce infant mortality have been more effective in reducing deaths in the second to twelfth months than in the first month of life,

* Woodbury (1925).

and particularly in the first day. Since deaths during the first month are chiefly due to prenatal and natal causes (84 per cent. of the neonatal deaths in 1940), increasing attention has been directed in the last few years towards reducing deaths from these causes. Measures directed towards this end include extension of prenatal services, measures to provide medical and nursing care for the mother at the time of childbirth and for the newborn infant, efforts to make hospital care for maternity patients more generally available and to raise the standards of hospital care for maternity patients and newborn infants, and special measures for the protection of premature infants.

In most of our large cities women who are unable to pay the cost of maternity care can receive such care at clinics and hospitals or through home delivery services, although in some cities where there is unusual crowding as a result of war activities the services normally available are inadequate under present conditions. The steps that are being taken to provide maternity care in rural areas and small cities are described on pp. 17–29 of the booklet *Maternal and Child-Health Services Under the Social Security Act.* The extent to which nursing or medical care at the time of childbirth are made available from public funds to those who cannot pay is, as yet, very limited outside of the large cities.

Efforts to raise the standard of hospital care of maternity patients and newborn infants have taken various forms. Physicians and hospital administrators, through their professional organizations, are continuously educating their own members. Certain cities, notably New York and Chicago, have established minimal standards for hospital maternity services that are enforced as public health regulations. Many States have licensing authority over maternity homes and hospitals and are attempting to enforce minimal standards in so far as they have the personnel to carry on this function.

The mimeographed outline of *Standards and Recommendations for Hospital Care of Newborn Full-Term and Premature Infants,* which I am sending, has been prepared recently in the Children's Bureau, in consultation with the United States Public Health Service and with the advice of committees of obstetricians and pediatricians. Relatively few of the maternity services in our hospitals can meet these standards at the present time, but it is believed that it will be helpful to set before them a yardstick for evaluation of their services and a goal toward which to work.

Premature birth is the most important single cause of death during the first month of life ; 46 per cent. of all neonatal deaths in 1940 were attributed to this cause. Recognising this, increased efforts have been made in the last few years to provide better care for infants born prematurely. This problem and the steps being taken to meet it are described in the publications : *Mortality from Premature Birth in the United States* ; *Birth Weight and Its Relation to Neonatal Mortality* * ; *The Care of the Premature Infant* † ; *The Premature Infant in the Public Health Program* ‡ ; *The Care of Premature Infants, a Plan of Co-operation Between Hospital and Public-Health-Nursing Services* § ; *Standards for Care of Premature Infants in Hospitals Having a Maternity Service* ; *Provisions for Care of Premature Infants* (abstracts from the 1941 plans for maternal and child health services submitted to the Children's Bureau from the various States).

The Children's Bureau has for several years conducted studies of the physiology and care of premature infants. The results of studies of incubators for premature infants are being sent you.

The pamphlet *Maternity Care for Wives of Men in Military Service and Medical Care for Their Children* describes a special war-time service recently developed as a part of the maternal and child health program under the Social Security Act.

One other phase of the maternal and child health program that is important in prevention of infant mortality is that of postgraduate education in pediatrics and obstetrics for practising physicians. This is described on pp. 66–68 of *Maternal and Child-Health Services Under the Social Security Act.*

At the 1940 White House Conference on Children in a Democracy, recom-

* Duffield *et al.* (1940).

† Dunham and Bierman (1940).

‡ Dunham and Rothert (1941).

§ Koenig (1940).

mendations were made for a program for the next ten years for promotion of all phases of child welfare. The recommendations pertaining to child health are reported in the chapter beginning on p. 51 of the general report of the Conference.

With regard to your specific questions, I shall try to answer them as far as possible.

1. What is the importance of poor housing and overcrowding ?

As shown in the studies reported in *Causal Factors in Infant Mortality,** poor housing and crowding bear a definite relation to infant mortality. Study of infant mortality rates for various sections of a city usually shows that higher rates prevail in those sections in which there is crowding and poor housing.

It is difficult to be certain to what extent crowding and poor housing are actually a cause of higher mortality of infants because they are always associated with other factors, such as low economic level, and lower educational level of parents.

2. What is the numerical ratio of health visitors per 1,000 births ?

In the United States, health visitors such as are employed in Great Britain are not utilized in the community health programs. Public health nurses are employed by official and non-official agencies.

I am sending a map which shows the population per public health nurse in urban and rural areas in each State as of January 1, 1940. We do not have figures on the number of nurses in proportion to births, though this could be calculated from the data on the reverse side of this map and the number of live births given on the reverse of the map showing birth rate in each State. Since there are relatively few specialized maternal and child health public-health-nursing services and the tendency is more and more toward generalized services, calculations based on the ratio of nurses to live births are not particularly appropriate.

In general, it is considered that to provide adequate service there should be one public health nurse for every 2,000 population, but for any given locality the number of nurses needed will depend upon the type of community and upon how effectively the services are organized to avoid duplication and provide for maximum efficiency.

3. How are health visitors trained ?

Since we do not have health visitors, I am substituting a brief outline of the qualifications of public health nurses engaged in direct service :

Academic education—
High school graduation.

Professional education—
Completion of basic three-year program of study in an approved school of nursing and licensed to practise. Satisfactory completion of university program of study in public health nursing granting academic credit.

The qualifications of supervisors and administrators in public health nursing, in addition to the above, are usually college graduation and additional preparation in public health nursing supervision and administration.

Public health nurses in all State programs and in a large proportion of city programs do generalized public health nursing, including maternal and child health services as a part of their generalized service. The services in which public health nurses participate which relate specifically to infant care are :

Maternity—
Prenatal supervision
Through home visits ;
Through clinic service ;
Teaching group classes of mothers.
Nursing assistance at deliveries in the home.

* Woodbury (1925).

Postpartum nursing care.

Infant health supervision—
Throughout infancy and pre-school period
In home ;
In clinic.

I am sending tables giving figures on the number of public health nurses in the United States employed by different types of agencies, and on the qualifications of these nurses ; also a statement prepared at the time the maternal and child health services under the Social Security Act were inaugurated, showing the implications of that program for public health nursing.

4. What are the standards of provision of beds for premature and sick babies per 1,000 births?

No definite standards have been established. It has been recommended that the maternity services of hospitals provide for care of five or six premature infants for every 100 live births. But since premature infants remain in the hospital longer than full-term infants, and certain types of infants which, strictly speaking, are not in the premature category nevertheless need the same special care, it is suggested that the provision for premature infants should be on the basis of 15 to 20 per cent. of the total live births.

5. What provision is there for convalescent care of sick babies?

There is no public program providing institutional convalescent care for sick infants. Public health nurses instruct parents regarding the care of infants who are sick or convalescing in their homes. There are some private institutions for convalescent care of sick babies in cities. Most of the convalescent services are for older children, particularly those with heart disease.

6. What percentage of babies are breast fed?

No figures are available. The percentage probably varies greatly in different population groups.

7. What measures are taken to educate mothers in infant feeding?

In the prenatal clinic—
Advice to mother as to how she can prepare herself to nurse her baby.
In the child health clinic—
Instruction by physician ;
Instruction and demonstrations by public health nurses
In individual conferences with the mother ;
In group conferences.
Home nursing visits by public health nurses—
Instruction ;
Demonstration.
Distribution of literature.

Samples of the literature regarding care and feeding of infants prepared for parents by the Children's Bureau are being sent you. These publications and others prepared by State or city health departments or private agencies are given to parents at prenatal and child health clinics, and by nurses at home visits. The publications are also sent directly to parents upon request. It has been found that printed material is more effective when it is used to reinforce or supplement specific advice by the doctor or nurse than it is when distributed without explanation as to its use.

The publications to which I have referred, together with some additional material, are being sent you under separate cover. If they are not received within a reasonable time, please let me know.

If the Children's Bureau can be of any further assistance at any time, I hope you will let us know.

Very sincerely yours,

(Sgd.) MARIAN M. CRANE, M.D.,
Assistant Director, Division of Research in Child Development.

BIBLIOGRAPHY

OFFICIAL STATISTICS AND REPORT

Australia

Commonwealth Bureau of Census and Statistics. Official Year Books, 1927 to 1939. Government Printer, Canberra, 1927 to 1940.

Canada

Dominion Bureau of Statistics. Vital Statistics of Canada, 1941. Ottawa, 1942. A study of maternal, infant and neonatal mortality in Canada. Ottawa, 1942.

England and Wales

Chief Medical Officer to the Ministry of Health. Annual Reports, 1937 and 1938. H.M.S.O. London, 1938 ; 1939.

Medical Officer to the Privy Council. 5th and 6th Reports. H.M.S.O. London, 1863 ; 1864.

Ministry of Health. Annual Reports, 1936–37 and 1937–38. H.M.S.O. London, 1937 ; 1938. Report on overcrowding in England and Wales 1936. H.M.S.O. London, 1936.

Ministry of Labour. Monthly Gazette, Dec. 1936 ; Dec. 1937 ; Dec. 1938.

Registrar-General. Annual Reports, 1905 to 1920. H.M.S.O. London, 1906 to 1921. Decennial Supplement, 1931. Part IIa. Occupational Mortality. H.M.S.O. London, 1938. Quarterly returns, 1939 to 1941. H.M.S.O. London, 1939 to 1942. Statistical Reviews, 1921 to 1938. H.M.S.O. London, 1922 to 1939.

League of Nations

Statistical Year-books, 1933–34 to 1940–41. Geneva, 1934 to 1941.

League of Nations Technical Commission. (1935, 1936.) Report on the physiological bases of nutrition. A. 12 (*a*), 1936, IIb. Geneva.

New Zealand

Director-General of Health. Report for the Year ended 31st March 1935. Government Printer, Wellington, 1935. Report for the Year ended 31st March 1942. Government Printer, Wellington, 1942.

Department of Census and Statistics. Official Year-books, 1926 to 1941. Government Printer, Wellington, 1925 to 1941.

Norway

Public Health Department, Oslo. Private Communication. 1937.

Scotland

Central Midwives Board for Scotland. Rules. Robb, Edinburgh, 1938.

Clinical Medical Officer, City of Edinburgh. Annual Report of the Maternity and Child Welfare Scheme for the year 1938. Mackay, Leith.

Department of Health. Annual Reports 1936 to 1938. H.M.S.O. Edinburgh, 1937 to 1939. Seventh Report on Incapacitating Sickness in the Insured Population of Scotland. H.M.S.O. Edinburgh, 1937.

Medical Officer, Burgh of St. Andrews. Report for the Year 1931. University Press, St. Andrews, 1932.

Medical Officer of Health, City of Aberdeen. Annual Report for 1926. Cornwall, Aberdeen, 1927.

Medical Officer of Health, City of Glasgow. Report, 1939. Corporation Printing Department.

Registrar-General. Annual Reports for 1905 to 1940. H.M.S.O. Edinburgh, 1906 to 1942. Quarterly Returns for 1939 to 1943. H.M.S.O. Edinburgh, 1939 to 1943.

Royal Maternity and Women's Hospital, Glasgow. Medical Report for the Year 1941. Aird and Coghill, Glasgow, 1942.

Union of South Africa

Union Office of Census and Statistics. Official Year-Books, 1936 to 1941. Government Printer, Pretoria, 1936 to 1941.

United States of America

Department of Commerce. Bureau of the Census. Vital Statistics—Special Reports, Vol. 7, No. 55, page 567. Infant Mortality : United States. Washington, 1939.

Department of Labor. Children's Bureau. The Children's Bureau To-day. Washington, 1942. Facts about Child Health. Washington, 1942. Standards and Recommendations for Hospital Care of Newborn Full-term and Premature Infants. October 1942. Standards for Care of Premature Infants in Hospitals having a Maternity Service. Provisions for Care of Premature Infants. 1941 State M.C.H. Plans. An Emergency Kit for Premature Infants. Washington, 1942. Incubators for Premature Infants, 1942. Maternity Care for Wives of Men in Military Service and Medical Care for their Children. Washington, 1942. Chart No. B 39–5. Attendant at Birth. United States. 1939. May 1941. Chart No. IM 39–3. Infant Mortality Rates by Age. May 1941. Chart No. IM 39–7. Infant Mortality Rates by Cause and by Age. May 1941. Chart No. MM 39–8. [Live Births.] August 1941. Chart (without number). Infant Mortality—Urban and Rural Areas, 1915–38. Publication No. 142. Woodbury, R.M. Causal Factors in Infant Mortality. Government Printing Office, Washington, 1925. Publication No. 246. Proceedings of Conference on Better Care for Mothers and Babies. Government Printing Office, Washington, 1938. Publication No. 259. Maternal and Child-Health Services Under the Social Security Act. Development of Program, 1936–39. Government Printing Office, Washington, 1941. Publication No. 261. The Child-Health Conference. Government Printing Office, Washington, 1941. Reprint. Mortality from Premature Birth in the United States. (The Child—Monthly Bulletin, 1942, 6, 227.) Reprint. Incubators for the Premature Baby. (Public Health Nursing, 1942, May.)

Health Department, City of Chicago. Report of the Board of Health for the year 1940.

Public Health Service. Total Number of Public Health Nurses employed in the United States and in the Territories of Hawaii and Alaska on January first of the Years 1937, 1938, 1939, 1940 and 1941. Population per Public Health Nurse in Urban and Rural Areas in Each State. January 1, 1940. Public Health Reports (1934), **49,** 117 ; (1936), **51,** 112 ; (1938), **53,** 99 ; (1940), **55,** 208.

White House Conference on Children in a Democracy. General Report, Washington, 1940.

OTHER REFERENCES

ANDERSON, G. E. (1940), *Amer. J. Obstet. Gynecol.*, **40,** 517.
ANDERSON, N. A., BROWN, E. W., and LYON, R. A. (1941), *Amer. J. Dis. Child.*, **61, 72.**
ANDERSON, N. A., and LYON, R. A. (1939), *Amer. J. Dis. Child.*, **58,** 586.
BARNUM, C. G., and WOODWARD, J. C. (1938), *J. Amer. Med. Assoc.*, **111,** 1749.
BEST, W. H. (1938), *J. Amer. Med. Assoc.*, **110,** 1155.
BREESE, B. B. (1938), *J. Pediat.* **12,** 648.
BUNDESEN, H. N. Health Dept., City of Chicago. Report of Board of Health, 1940.
BUNDESEN, H. N., DAHMS, O. A., FISHBEIN, W. I., and HARMON, G. E. (1936), *J. Amer. Med. Assoc.*, **107,** 270.
BUNDESEN, H. N., FISHBEIN, W. I., DAHMS, O. A., and POTTER, E. L. (1937), *J. Amer. Med. Assoc.*, **109,** 337.
BUNDESEN, H. N., FISHBEIN, W. I., DAHMS, O. A., POTTER, E. L., and VOLKE, W. (1938), *J. Amer. Med. Assoc.*, **111,** 134.
BURNS, C. M. (1942). Infant and Maternal Mortality. Dept. Physiol., King's College, Univ. Durham. Carr, Newcastle-upon-Tyne.
CAMPBELL, J., and MCKINLAY, P. L. (1929). Reports on Public Health and Medical Subjects No. 55, Ministry of Health. H.M.S.O. London.
CLIFFORD, S. H. (1934), *J. Amer. Med. Assoc.*, **103,** 1117. *J. Pediat.*, **5,** 139.
COMMITTEE OF AMERICAN DIETETIC ASSOCIATION (1939), *J. Amer. Dietetic Assoc.*, **15,** 776.
CRAIG, W. S. (1936), *Lancet,* **231,** 68.
CRAIG, W. S. (1936), *Arch. Dis. Childhood,* **11,** 171.
CRAWFORD, W., and BROADLEY, H. (1938). The People's Food. Heinemann, London.
CROWLEY, N., DOWNIE, A. W., FULTON, F., and WILSON, G. S. (1941), *Lancet,* **241,** 590.
DAVIDSON, L. S. P., DAVIS, L. J., and INNES, J. (1942), *Brit. Med. J.*, ii, 31.
DE SNOO, K. (1937), *Amer. J. Obstet. Gynecol.*, **34,** 911.
DE SNOO, K. (1938), *Geneesk. Tijdschr. Nederland.-Indië,* **78,** 634.
DUFFIELD, T. J., PARKER, S. L., and BAUMGARTNER, L. (1940), *The Child—Monthly Bulletin,* **5,** Nos. 5 and 6, 123.
DUNHAM, E. C., and BIERMAN, J. M. (1940), *J. Amer. Med. Assoc.*, **115,** 658.
DUNHAM, E. C., and ROTHERT, F. C. (1941), *The Mississippi Doctor,* p. 626.
DUNHAM, E. C., TANDY, E. C., DAILY, E. F., and HAYES, C. E. (1938), *Amer. J. Pub. Health,* **28,** 491.
EBBS, J. H., SCOTT, W. A., TISDALL, F. F., MOYLE, W. J., and BELL, M. (1942), *Canad. Med. Assoc. J.*, **46,** 1.
EDEN, T. W. (1931), *Lancet,* **221,** 1223.
ELDERTON (1925), quoted by TITMUSS (1943).
FLAX, L., LEVERT, E. L., and STRONG, R. A. (1942), *J. Pediat.*, **21,** 717.
FULLERTON, H. W. (1943), *Brit Med. J.*, i, 158.
GORDON, I. (1942), *Arch. Dis. Childhood,* **17,** 139.
GRAHAM, S. (1939), *Arch. Dis. Childhood,* **14,** 277.
GRAHAM, S. (1940), *Lancet.*, **238,** 1107.
HALLIDAY, J. L. (1928), *M.R.C. Spec. Rep. Ser.*, No. 120. H.M.S.O. London.
HENDERSON, J. L. (1943), *Brit. Med. J.*, i, 410.
HESS, J. H. (1936), *J. Amer. Med. Assoc.*, **107,** 400.
HUGHES, E. L. (1942), *Brit. Med. J.*, ii, 69.
HUMMEL, F. C., HUNSCHER, H. A., BATES, M. F., BONNER, P., MACY, I. G., and JOHNSTON, J. A. (1937), *J. Nutrition,* **13,** 263.
HUTCHISON, J. H. (1938), *Arch. Dis. Childhood,* **13,** 355.
JACOBI, A. (1911), *Amer. J. Dis. Child.*, **1,** 1.
JOINT COMMITTEE OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON AND THE BRITISH COLLEGE OF OBSTETRICIANS AND GYNÆCOLOGISTS (1938), *Brit. Med. J.*, i, 1011.
JUNDELL, I. (1939), *Amer. J. Dis. Child.*, **57,** 1411.
KOENIG, H. (1940), *The Child—Monthly Bulletin,* **5,** No. 3.
LESCHER, F. G. (1942), *Lancet,* **243,** 148 ; 152.
LUDLAM, G. B., and HENDERSON, J. L. (1942), *Lancet,* **242,** 64.

McCance, R. A., Widdowson, E. M., and Verdon-Roe, C. M. (1938), *J. Hyg.*, **38**, 596.
McClure, W. B. (1943), J. Pediat., **22**, 60.
McGonigle, G. C. M., and Kirby, J. (1936), Poverty and Public Health. Gollancz, London.
Macgregor, A. R. (1939), *Arch. Dis. Childhood*, **14**, 323.
McIlroy, L. (1934), *Lancet*, **227**, 291 ; 345.
McIntosh, J., and Morris, N. (1941), *Glasgow Med. J.*, **136**, 103.
McNeil, C. (1942), *Glasgow Med. J.*, **19**, 87.
Miller, H. G., and Studdert, T. C. (1942), *Lancet*, **243**, 332.
National Research Council (1941), *U.S. Pub. Health Rep., Washington*, **56**, 1233.
Ormiston, G. (1941), *Lancet*, **241**, 588.
Orr, J. B. (1936), Food, Health and Income. Macmillan, London.
Peckham, M. D. (1938), *J. Pediat.* **13**, 474 ; 484.
People's League of Health (1942), *Lancet*, **243**, 10. *Brit. Med. J.*, ii, 77.
Pomerance, W., and Daichman, I. (1940), *Amer. J. Obstet. Gynecol.*, **40**, 463.
Potter, E. L., and Adair, F. L. (1938), *J. Amer. Med. Assoc.*, **112**, 1549.
Rice, J. L., Best, W. H., Frant, S., and Abramson, H. (1937), *J. Amer. Med. Assoc.*, **109**, 475.
Rietz, E. (1930), Sterblichkeit und Todesursachen in den Kinderjahren. *Acta Pediat.*, **9**, Suppl. 3, Uppsala. Quoted by Titmuss (1943).
Robinson, M. (1939), *Arch. Dis. Childhood*, **14**, 259.
Rose, M. S. (1935), *Nutrition Abstracts and Reviews*, **4**, 439.
Schiøtz, C. (1934), *Acta Pediat.*, **15**, Suppl. 1.
Sommers, H. J. (1942), *Pub. Health Rep., Washington*, **57**, 1494.
Spence, J. C. (1938), *Brit. Med. J.*, ii, 729.
Spence, J. C., and Miller, F. J. W. (1941), Infantile Mortality in Newcastle-upon-Tyne during 1939. Christie and Malcolm, Newcastle-upon-Tyne.
Stevenson, E. M. K. (1938), *Edinb. Med. J.*, 1938, **45** (N.S.) ; *Trans. Edinb. Obstet. Soc.*, 81.
Stiebeling, H. K. (1939), *U.S. Dept. Agric. Year-book of Agric.*, 1939, p. 380.
Strauss, M. B. (1935), *J. Clin. Invest.*, **14**, 710.
Strauss, M. B. (1935), *Amer. J. Med. Sci.*, **190**, 811.
Strauss, M. B. (1937), *Amer. J. Med. Sci.*, **194**, 772.
Strauss, M. B. (1939), *Amer. J. Obstet. Gynecol.*, **38**, 199.
Theobald, G. W. (1937), *Lancet*, **232**, 1397.
Tisdall, F. F., Willard, A. C., and Bell, M. (Nov. 1941), Mayor's Office, Toronto.
Titmuss, R. M. (1943), Birth, Poverty and Wealth : A Study of Infant Mortality. Hamish Hamilton Medical Books, London.
Ungley, C. C. (1938), *Lancet*, **234**, 925.
Wadlow, E. E. (1940), *Amer. J. Obstet. Gynecol.*, **39**, 749.
Williams, J. E. (1936), *Nature*, **137**, 529.
Williams, J. E. (1937), *Pub. Health*, **50**, 231.
Williams, J. E. (1938), *Pub. Health*, **51**, 185.
Williams, P. F., and Fralin, F. G. (1942), *Amer. J. Obstet. Gynecol.*, **43**, 1.
Wills, L., Mackay, H. M. M., Bingham, K., and Dobbs, R. H. (1942), *J. Hyg.*, **42**, 505.
Woodbury, R. M. (1925), *U.S. Dept. Labor, Child. Bur. Pub.*, No. 142. Government Printing Office, Washington.
Woodbury, R. M. (1926), Infant Mortality and Its Causes. Williams and Wilkins, Baltimore.
Yerushalmy, J. (1938), *Amer. J. Hyg.*, **28**, 244.
Yerushalmy, J. (1940), *Pub. Health Rep., Washington*, **55**, 1195.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
By Morrison & Gibb Ltd., Edinburgh and London

Report of the Committee on Post-War Hospital Problems in Scotland

THIS Report, published in October 1943, is the result of some twenty months' investigations by a Committee under the chairmanship of Sir Hector Hetherington, LL.D.

Such important aspects of post-war hospital policy as the financial relations between voluntary hospitals and their patients, the financial relations between local authorities and voluntary hospitals, and the future administration of the State hospitals specially built as part of the Emergency Medical Service are discussed and recommendations are made.

Price 9d. net (10d. including postage)

HIS MAJESTY'S STATIONERY OFFICE

EDINBURGH 2: 120 George Street
LONDON, W.C. 2: York House, Kingsway MANCHESTER 2 :39/41 King Street
CARDIFF: 1 St Andrew's Crescent BELFAST: 80 Chichester Street
or through any bookseller

(120) Wt 53175–1387 1500 12/43 G 21 S.O. Code No. 49–275
(36) Wt 55972–198 1000 2/44